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The Outlook

Fighter Protection

IF a man's house is burgled, he often exclaims that the police are never about when they are wanted. In the same way those who see an enemy bomber overhead, and perhaps suffer from its presence, are apt to exclaim that our fighters are never about when they are wanted. It was the same in the last war, when our infantry often complained that the R.F.C. was giving them no protection. They could not see our offensive patrols fighting far on the German side of the lines, and so giving better protection than they could have given by remaining within sight of the infantry. The French were rather inclined to say the same thing during the recent battle on the Somme and the Aisne, when R.A.F. squadrons starting from England were doing a lot to hamper the Germans' advance, but did not come within sight of the French troops.

When the Germans are raiding sporadically every day, as they are now, it is not possible for our fighters to be everywhere. They have to be grouped in tactical positions from which they can give the maximum amount of protection to the country as a whole. We cannot post one Spitfire as a sentry over every village in Great Britain. The more the enemy raiders split up, the harder it is for our fighters to catch every one. In cloudy weather, particularly, lone machines must often be able to slip through, dodge to and fro, and reach localities where they can do their fell work without interference. They are very difficult to intercept, but that does not mean that they will necessarily get home with whole skins. We cannot even hope to build an impenetrable wall round our island. The object of our fighters is to inflict casualties, for nothing is so discouraging to raiders as to have to pay a heavy butchers' bill every day.

So far, our monthly casualties among civilians have been lower than the deaths on the roads, while the raiders are suffering substantial losses. The Germans can have little cause for self-congratulation.

Waste of Quality

THERE is a matter of moment to which we would draw attention. We are all urged by the Government to avoid waste in every way. If aluminium is more useful in making a Spitfire than in boiling a cauliflower, then we must send our cooking pots to the aircraft factories. But the Services themselves, not excluding our well-beloved Royal Air Force, are not always meticulously careful in avoiding waste of human material. Even the R.A.F. sometimes insists on its human aluminium boiling cauliflowers when it ought to be used in Spitfires. We know of officers who have taken special courses which should qualify them as, say, engine experts (of whom the R.A.F. can hardly have too many) but who, through some laches in forwarding recommendations, seem destined to remain on General Duties, which other men less specially qualified could do quite as well or better. We insist that human material is precious, and that waste of it should be absolutely abolished. Slackness in dealing with special applications and recommendations is not a venial offence. Some firm action by the Air Ministry seems to be indicated.

Promotion in the Volunteer Reserve

IT has been laid down and published that a Pilot Officer in the R.A.F. Volunteer Reserve (and all R.A.F. commissions are now given in the V.R.) shall, if recommended by his Commanding Officer, be promoted to Flying Officer after twelve months' satisfactory service. It would, of course, be simpler if the Air Ministry took the initiative and automatically

gazetted all promotions on the due date; but it is felt, quite reasonably, that the recommendation of a C.O. is necessary, as the officer in question may not be suitable for promotion, and the Air Ministry would not always know the facts.

The present system is not working too well. Cases have come to our knowledge of officers whose promotion has been delayed for no reason except carelessness or inefficiency in the H.Q. offices of either Station or Group. Matters may be complicated if an officer is transferred from one Group to another, or if a certain adjutant gets transferred. Such things may be a reason for muddle and delay, but they are not an excuse. Promotion is a very important matter to an officer, and more particularly to a V.R. officer, who may be married and have left a well-paid post to join the Service.

The cases of which we have heard are sufficiently numerous to justify us in calling on the Air Ministry to take up this matter with energy, and to insist that any carelessness in dealing with promotions by the staffs of Groups or subordinate units should be treated with some severity.

Expensive Aluminium

DAILY paper reports state that Mr. Richard Archbold has been approached by the Ministry of Aircraft Production in connection with the sale of his flying boat *Guba* for the purpose of flying 3½-ton cargoes of aluminium across the Atlantic twice a week.

Guba is a Consolidated Model 28, with empty weight, 14,240lb.; disposable load, 12,840lb.; and a total loaded weight of 27,080lb. It would need a crew of four, and would consume approximately 78 gallons per hour at an airspeed of 164 m.p.h. (imperial gallons and land miles). To fly non-stop between Botwood and Foynes it would have to take aboard about 1,100 gallons of petrol, weighing 8,250lb. A cargo of only 1½ tons of aluminium could be carried, which is vastly different from the 3½ tons spoken about.

If such a proposal is seriously contemplated it can only mean one of two things, either that we are very short of aluminium and so have to resort to a tremendously expensive way of transporting a minute amount per week, or that the Ministry of Aircraft Production is out at all costs to impress the lay public (and perhaps lay Members of Parliament) with the effective manner in which it is doing its work. The Ministry's work probably is effective—we have seen nothing so far to suggest otherwise—but surely such a step as this is not necessary?

If *Guba* is for sale, it could be put to much better use either as a military boat on long-range patrol work, or as a civil boat, if it was desired to fly the Indian Ocean route between Mombasa and Australia (as was suggested in *Flight* of June 27, on page 562). This was the actual boat with which the survey flight was made. As the war has made us very short of long-range civil boats, this seems a magnificent opportunity to acquire one, for its still-air range with no reserve at a cruising power of 65 per cent. is about 3,100 miles.

THE KING WITH THE FLEET AIR ARM: His Majesty inspecting air crews at a south coast naval port recently. The machine in the background is a Pegasus-engined Blackburn Shark.

WAR in the AIR

The Dover Fight: The Red Cross Abused: Sea Gladiators: Italian Losses

OVER DOVER OVER: Some of the fighter pilots who took part in the recent fight over Dover harbour when some eighteen out of eighty German machines were destroyed in half an hour. The pilot in the foreground is already wearing the D.F.C. ribbon.

ON Monday, July 29, a great air battle was fought over Dover. The Germans attempted a surprise attack on the harbour in the morning, and sent across thirty Ju. 87 dive-bombers in formations of eight, while some fifty Messerschmitts formed a circle overhead in an attempt to protect them. The Germans approached from out of the sun, but the anti-aircraft gunners were not taken by surprise, and promptly shot down two enemy aircraft. Then squadrons of Spitfires and Hurricanes quickly arrived on the scene, and followed their usual tactics of detaching one party to hold off the German fighters while another lot went for the bombers. It would appear from such reports as have been made public that the Spitfires concentrated on the Messerschmitts and the Hurricanes on the Junkers, but any one of them was willing and ready to take on any enemy which came across his sights. The action raged for half an hour, and in that time our pilots shot down seven Messerschmitts and eight Junkers. Two only of our fighters were lost—ample testimony to the superiority of our machines and pilots over the Messerschmitts, though whether the latter were of the 109 or 110 variety, or a mixture of both, has not been stated. Dive-bombing on ships in harbour (not including capital ships with heavy deck armour) has been reckoned a deadly form of attack, but the fierce attentions of our fighters put the Germans badly off their aim. The bombs dropped in the harbour and rocked the ships moored there, but no sinkings have been reported.

Fighter Escorts

THE list of our victories in this combat shows the great advantage which the possession of the French coast has given the Germans, by allowing them to send fighter escorts with their bombers. Certainly the result was not what the enemy must have hoped, but had there been no Messerschmitts overhead, the losses among the dive-bombers would surely have been much heavier. For fairly obvious reasons it must take longer for our fighters to overcome enemy fighters than to shoot down bombers; the reports tell of several instances where our fighters had to break off and swerve away because Messerschmitts had got on their tails. So we may reasonably conclude that had our men been able to concentrate all their energies on the Junkers, a much larger total would have fallen to our A.A. and Browning guns. However, 17 or 18 enemy aircraft in half an hour was not bad going, and as some more individual raiders fell to our fighter patrols in the afternoon, the total bag for the day was 21 German machines.

Some details of the fighting were as follows:—Spitfires of one squadron destroyed four Messerschmitts and a bomber. Their success was equalled by pilots of a Hurricane squadron who shot down four bombers and a fighter. A Flight Lieutenant in this latter squadron reported that after his attack a Junkers blew up in mid-air and fell into the sea in flames. He then attacked a second Junkers from astern and saw his machine-gun bullets enter the fuselage. But he had to break off the engagement when a Messerschmitt got on his tail. A Pilot Officer attacked a formation of 12 bombers flying low over the sea. After a short burst the Hurricane pilot saw the last machine dive into the water. While firing at two Junkers a sergeant pilot was attacked by fighters. Swerving quickly to meet them he fired a burst at one and saw the German pilot bale out. Another sergeant, after firing two long bursts at a bomber, saw black smoke pouring from its fuselage. A third Hurricane sergeant was watching a dive-bomber he had attacked spinning down on fire out of control but he did not see it hit the water as he had to evade a German fighter. A Squadron Leader, flying a Spitfire, attacked a fighter and, after watching it go down out of control, engaged a bomber which dived into the water. From the same squadron a Pilot Officer attacked in turn three Junkers bombers. He saw one dive into the sea, the second go down on fire, while a third was damaged.

It has always been known that pilots of the *Luftwaffe* have no great enthusiasm for flying over the sea, and, indeed, it must be very unpleasant, even in summer, to have to spend hours in a rubber dinghy waiting for an R.A.F. launch to come out and rescue one—especially if another German machine comes along and shoots up the launch while it is trying to effect the rescue. So, as their casualty lists have grown, it seems that the German pilots have petitioned for ambulance seaplanes to be provided which will go out and look for flotsam airmen. At least, that is the story told by the crew of an ambulance seaplane which was forced down on to the water and finally towed into a British port. But there is a more sinister theory for the appearance of this novel type. These seaplanes, painted white and marked with the Red Cross, have been observed for some time past flying over British convoys a few miles from our coasts, and it is officially held that they have been reconnoitring and sending off wireless reports of our shipping movements. H.M. Government have caused the following communication to be made through the proper

WAR IN THE AIR (CONTINUED)

THE CROOKED CROSS: The Germans have been using machines bearing the Red Cross emblem for other than humanitarian purposes. One which was forced down clearly showed that it had been used for reconnaissance and photography. The Junkers shown here is not the type used in the recent incidents.

channels for transmission to the German and Italian Governments:—

"It has come to the notice of His Majesty's Government in the United Kingdom that enemy aircraft bearing civil markings and marked with the Red Cross have recently flown over British ships at sea and in the vicinity of the British coast, and that they are being employed for purposes which His Majesty's Government cannot regard as being consistent with the privileges generally accorded the Red Cross.

"His Majesty's Government desire to accord to ambulance aircraft reasonable facilities for the transportation of the sick and wounded, in accordance with the Red Cross Convention, and aircraft engaged in the direct evacuation of sick and wounded will be respected, provided that they comply with the relevant provisions of the Convention.

"His Majesty's Government are unable, however, to grant immunity to such aircraft flying over areas in which operations are in progress on land or at sea, or approaching British or Allied territory, or territory in British occupation, or British or Allied ships.

"Ambulance aircraft which do not comply with the above requirements will do so at their own risk and peril."

Two of these Red Cross seaplanes have been captured intact, and since then two more which were sighted in company with German fighter patrols were shot down into the sea. The Germans have shown on many occasions that the display of the Red Cross by the Allies only attracts their fire, and some American ambulances felt it safer to remove the emblem. It would be typical of the Hun to employ that emblem as a cover for warlike reconnaissance, trusting to the incredible British way of respecting international conventions and the decencies of civilised warfare.

A Polish Airman

DURING the month of July we shot down for certain 240 German aircraft, besides damaging many others, of which a large proportion could hardly have got home. It is calculated that this must mean the certain loss of 600 officers and men. Even to the large *Luftwaffe* such a loss in one month must be a consideration, for pilots and air crews cannot be turned out by production methods.

Whenever the weather permitted, the bombers of the R.A.F. have attacked military objectives in Germany and in the subjugated countries. In some of the raids French airmen have taken part, and in others Poles have been members of the crew. One Polish officer gave a vivid broadcast account of his experiences in a night raid on the aircraft factory at Gotha where Messerschmitts and other types are produced, as well as heavy tanks. "The impression that is most strong in my mind is the perfect collaboration of the crew," said the Polish officer. "I have never imagined that it could reach such a high standard. Every man was quiet and confident. Each of them knew what his task was and did it without fuss or bother." He was full of praise, too, for the navigation. "It was very exact," he said. "We were over the target practically to the minute on the estimated time of arrival, which had been set in advance. I was astonished at that because the weather conditions were poor. Most of the time we were flying in cloud." On the way out the bomber shot down a Me. 109. "I was sitting in the second pilot's seat, so I could not see the engagement," said the Polish officer. "It lasted only one minute or so. First I heard the sound of firing from an attacking aircraft, then right after that I heard firing from our own rear guns. Then a minute later the pilot said to me 'one Me. reported down, very good.' We passed north of the Ruhr. The anti-aircraft fire and searchlights there were very strong, but the pilot was all the time varying his course and speed and height, so we were not hit. After we had bombed the aircraft factory he turned to observe the effect of the

WHISTLE WHILE YOU WORK: A 500 k.g. whistling bomb being fitted to the ejector cradle of a Junkers Ju 87 dive-bomber

WAR IN THE AIR (CONTINUED)

attack. I saw several bright fires which we had started. The preceding bomber also had started two or three fires among the buildings. I was very glad to have the opportunity of taking part in this raid, for I have seen something of what the Germans have done to us in my own country. Coming back, we met more anti-aircraft fire and searchlights, but the captain merely put his fingers to his nose and laughed. He was a very fine young man."

The air bomb has scored two more successes against British destroyers. H.M.S. *Wren*, of 1,120 tons, sank after being bombed in an action between patrolling destroyers and enemy aircraft. During the fight another destroyer, H.M.S. *Montrose*, shot down two enemy bombers. H.M.S. *Delight* also sank after being bombed.

Italian Futilities

A CAIRO communiqué on Monday, July 29, reported the destruction of nine Italian machines. R.A.F. bombers, escorted by fighters, on reconnaissance over Eastern Libya, shot down one fighter and destroyed two on the ground. In Italian East Africa an Italian bomber was destroyed and two damaged during a raid on an aerodrome. Two Sunderland flying boats on patrol over the Mediterranean accounted for four fighters. One Italian fighter was brought down by anti-aircraft fire at Malta. French pilots and crews operating with the R.A.F. carried out a valuable reconnaissance in the Diredawa area of Abyssinia. Concentrations of troops and camel transports near Moyale, on the Kenya-Abyssinian border, were successfully bombed.

The *Regia Aeronautica* is still making abortive efforts to prove that Italy rules the Mediterranean waves, but the British Navy seems incredibly slow to recognise that alleged fact. One of the most trying of the Italian problems is to keep the Dodecanese islands and her other overseas possessions supplied with oil, water, and other essentials. The chartered Greek steamer *Hermione* was despatched to the Dodecanese with 300 tons of petrol and 200 tons of lubricating oil. One difficulty of the Italians is that if they send a naval escort with a tanker it may be caught by the British Navy, so this time they seem to have trusted to air escort. The *Hermione* was duly stopped by our naval patrols on the evening of Sunday, July 28, and the contraband character of her cargo was discovered. Then the Italian bombers arrived on the scene and began a heavy attack on our ships. They did not hit them or do any damage, but they made it impossible for them to bring the *Hermione* in as a prize. So we had to order the crew into the boats and sink the ship by gunfire. The weather was fine, and land was not far off, so the crew were in no danger. The Italians, of course, claimed that several British warships sustained severe damage, but admitted that many Italian machines were hit by "the violent anti-aircraft fire" of the ships. We believe the last statement.

Two Sea Gladiator aircraft of the Fleet Air Arm intercepted three Italian Savoia S.79 aircraft in the Mediterranean on Monday afternoon, July 29. One of the Italian machines was shot down in flames. A second was seen to be badly hit and it is considered unlikely that this machine has regained its base. One of our Sea Gladiators made a forced landing in the sea. The pilot was picked up unhurt.

It is now announced that during July R.A.F. machines attacked with apparently complete success two Italian submarines in the Mediterranean. On one occasion an aircraft on patrol sighted a submarine on the surface. The pilot immediately attacked, and the first salvo of bombs dropped so close to the stern that most probably the screw and the hydroplane were damaged. The submarine tried to submerge stern first, but the damage was evidently severe, for it manœuvred clumsily. Pressing home the attack, the Squadron Leader in charge dropped a second salvo when the conning tower was still above the surface, and direct hits were scored abaft the conning tower. The submarine was now completely submerged, but the attack was kept up and a final salvo of bombs crashed on the estimated position, whereupon air bubbles appeared on the surface. The aircraft cruised round for a considerable time and the bubbles continued, followed by a large patch of oil.

The other action was fought three days previously. British aircraft rushed to the attack when a submarine was sighted and dropped two salvoes of bombs, the first dropping 15 yards astern of the enemy. In the next attack, however, the aircraft found the target and a direct hit was scored abaft the conning tower. Nothing more was seen of the submarine, but an oil patch half a mile square formed on the surface and air bubbles rose for a considerable time. Though it is a ruse of submarines to release oil when attacked, these two seemed certainly destroyed.

Norwich Bombed

ON August 1 a single raider crossed our East Coast at a great height and dived out of a cloud on to Norwich down to about 400ft., where it opened fire with its machine-gun, afterwards dropping bombs. Several buildings were demolished, and some people were buried in the debris, but all were extricated, suffering only from shock. There was no panic, and the people behaved with admirable calm.

Recently the *Deutsche Allgemeine Zeitung*, writing about British air raids on Germany, said: "It is only natural that to stay in the air-raid shelters has become a nightly habit which is pursued until it is relieved by a full night's rest. Already people are almost surprised if such visits by the English have for once not taken place, and they make guesses as to why the night was quiet."

Australian Airliners Returned

THE Australian Minister for Air, Mr. J. V. Fairbairn, announced that the four Douglas DC3 airliners which had been taken over from the airlines, A.N.A. and A.O.A., for the use of the Royal Australian Air Force, would be returned, and no doubt have been by this time.

This is good news, for the commandeering of these aeroplanes must have severely handicapped the activities of the two companies, activities which are essential both in peace and war. Their addition to the strength of the R.A.A.F., which has about 80 Lockheed Hudsons at its command, would mean very little.

New Design of Floating Flare

COMMANDER H. T. BENNETT, control officer at the Rose Bay flying boat base, and Mr. R. D. Kennedy, both of the Civil Aviation Department of Australia, have designed a floating flare for night landings at the base. Several advantages are claimed for the flare, which is mounted at the top of a single vertical rod weighted at the bottom and with a kapok buoy about 30in. from the top. The flare is a brass streamlined container and has a fin which keeps it pointing into wind. Suitable shielding for the flame is arranged to prevent side gusts blowing on it, but a small inlet provides a supply of the requisite amount of air right on to the wick.

The container holds sufficient fuel for four hours' operation, and the design is such that heat dissipation is adequate to prevent the fuel reaching boiling point.

Causes of Accidents

OF 36 fatal aircraft accidents in March and April in U.S.A., 22 were due to violations of the regulations. Seventeen of the fatal accidents resulted from spins or stalls, this being the major cause. Other causes were low aerobatics staged over a pilot's home (intended to thrill his relatives and no doubt he did), overloading in the take-off, corrosion of a control cable due to poor maintenance, flight into adverse weather conditions, and failure in aerobatics of the wing of an old aeroplane.

In connection with this last it was recalled that nine structural failures (including seven fatalities) occurred during 1939 in fabric-covered aeroplanes which had been in service for seven years or more. It was recommended that the standard of inspection should be more rigorous than ever on aeroplanes of such an age. The corrosion of the control cable was due to the natural acids emanating from a piece of rawhide round it.

The Model 18S Beechcraft, winner of the 1940 Macfadden race of over 1,000 miles at a speed of 234 m.p.h.

BEECHCRAFT MODEL 18

Military and Commercial Versions of Fast Twin-engined Type

THE U.S. Army Air Corps has just released data about one of its newest types of aircraft, the Beechcraft Model C-45 twin-engine light personnel transport. The first units of this type have been tested and accepted by the Air Corps, and a number of additional transports are under construction by the Beech Aircraft Corporation, Wichita, Kansas, in fulfilment of a $458,764 contract.

The Model C-45 is an all-metal low-wing monoplane with flaps and retractable landing gear. The plane has the conventional flight instruments, and ice-removing and anti-icing equipment. No armament is carried. Two 400 h.p. Pratt & Whitney Wasp Jr. 5,000ft. direct drive nine-cylinder engines are used, with two-bladed metal airscrews of 8ft. 3in. diameter. Wing span of the C-45 is 47ft. 7½in.; length, 34ft. 2½in.; height, 9ft. 4in.; and chord, 96.6in. Approximate gross weight is 7,500 lb. Accommodation is provided for a crew of two and three passengers.

Performance figures for the C-45 transport were not made public by the Air Corps. The aeroplane is, however, similar in design to the commercial Model 18S Beechcraft, which also uses Wasp Junior engines. A stock model 18S Beechcraft won the 1940 Macfadden race for "NC" licensed airplanes, covering 1,084 miles from St. Louis to Miami, using normal cruising power, at an average speed of more than 234 miles per hour. With a service ceiling of 27,000ft., a single-engine ceiling of 12,300ft., and a rate of climb of 1,850 feet per minute at sea level, the Model 18S is one of the highest performance commercial aeroplanes carrying an approved type certificate to-day.

Two of another variation, the Model 18A, were placed in service on May 15 by Canadian Airways, Ltd., Canada's largest independent air operator. This model uses two Wright Whirlwind R-760-E2 engines of 350 h.p. each, and with eight or ten seats occupied, can carry over 550 lb. of freight at a cruising speed of 200 m.p.h.

The aircraft were purchased to meet expanding mail and passenger traffic in the Maritimes Division of Canadian Airways. Daily round-trip services are maintained between Moncton, New Brunswick and Halifax, Nova Scotia; Moncton and St. John; and Moncton and the Prince Edward Island cities of Summerside and Charlottetown. Connections are made at Moncton with the trans-continental flights of Trans-Canada Air Lines.

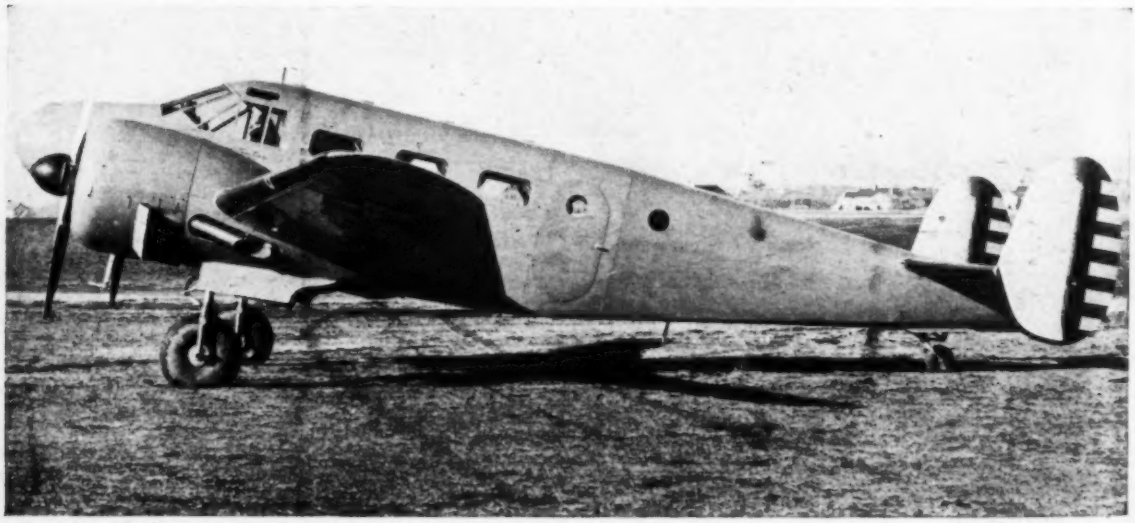
On the first leg of its delivery flight, from Wichita, Kansas, to Detroit, Michigan, one Beechcraft made an average speed of 239 m.p.h.

Anti-Espionage

A consideration of approximately $150,000, at the current rate of exchange, was involved in Canadian Airways' purchase of the two Beechcrafts. The two airliners are practically identical in design, except for the power plants, with the Macfadden race winner which is seen in our illustration above.

They also resemble the air survey Beechcrafts being built in quantity for the U.S. Army Air Corps, which are designed to make safe use of small, rough landing areas. An ample margin of safety is thus provided for Maritimes operations, in which small airports are necessarily utilised.

Included in the equipment of the Beechcrafts are the usual airline instruments, two-way and navigational radio, also complete de-icing equipment, and provision for installing ski landing gear or seaplane floats. Also fitted are special "black-out blinds," controlled from the pilot's compartment, which completely cover all the windows within the passenger cabin. Canadian Government regulations require that these blinds be drawn when the planes are passing over certain prescribed areas on their routes, for protection against espionage from the air. This arrangement is more desirable than a permanent "black-out."



The C-45 transport is one of the U.S. Army Air Corps' new types and has been developed from the commercial Model 18S. The unusually small gills on the lower part of the cowling, and the whip aerial, may be noticed.

AN AEROPLANE WITH A "BACKGROUND"

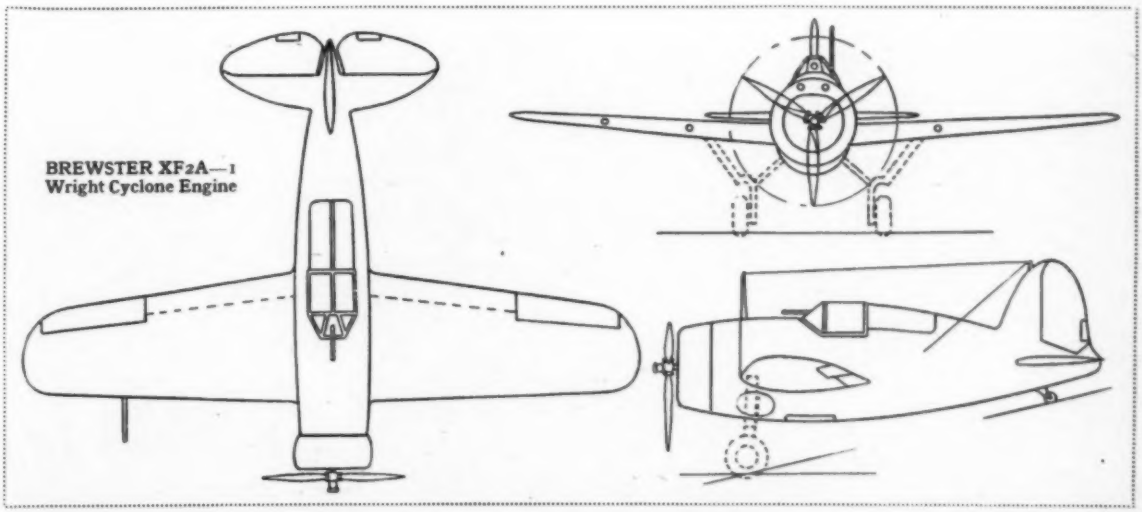
American Fighter may soon be seen in Service in this Country

AMONG the types of American military aircraft which have been announced to be on order for the British Air Ministry is the Brewster fighter. As the machine may be seen over the English countryside soon, and as Service pilots will be handling it, it is thought that a description may be of interest to Service and civilian readers alike.

One is so accustomed to thinking of anything American as necessarily "new" that it comes as something of a surprise to find that in the case of the Brewster its ancestry, so to speak, goes back to the 1800s. Round about that time a young man by the name of James Brewster decided that the time had come when America should be independent of foreign countries for her high-quality horse-drawn carriages. The revolution was over, and after a period of depression prosperity began to return. Somewhere around 1810 he started his own business in New England, and by 1826 the business had grown to such an extent that it was decided to open a branch in New York. The official title of the company was "Messrs. Brewster and Co. (Broome Street)." Twenty years later the firm moved to new premises which occupied what is now the block on Broadway between 47th and 48th Streets.

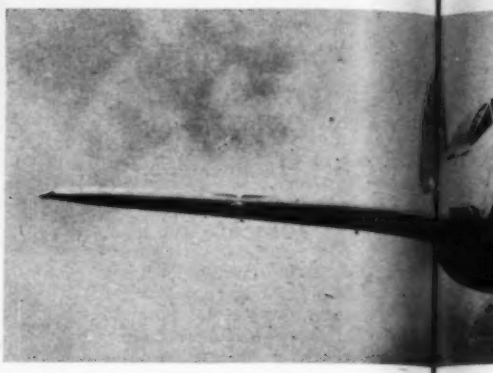
The next important event in the history of the firm was the coming of the motor car and the transfer of the Brewster works to Long Island City, where the Brewster reputation for fine coachwork was established. Here it is of interest to recall a fact which is probably unknown to most people in this country. When the Rolls-Royce firm "invaded" the United States it was the Brewster company which built the bodies. That fact alone bears witness to the esteem in which Brewster products were held.

So far as can be ascertained, the entry into the aviation industry took place in 1920 or so, when the firm undertook to build duralumin seaplane floats for the U.S. Navy. Later they were pioneers in the construction of spot-welded stainless steel floats. A bold step was taken in the early 1930s, in the middle of a depression, when James Work took over the aviation division of the Brewster concern and formed as a separate company the Brewster Aeronautical Corporation. Mr. Work was an aeronautical engineer of many years' standing, having been associated with the Naval Air Station at Lakehurst, and the Naval Aircraft Factory at Philadelphia, and later with the Detroit Aircraft Corporation. Under his leadership a start was made with the manufacture of wings and tails for the Grumman biplane fighters. Perhaps this explains the similarity between the Brewster and Grumman designs, when, in 1934, the firm decided to start out with their own types under the technical leadership of Mr. Dayton T. Brown, who had been with Mr. Work at the Naval Aircraft Factory and at the Detroit Aircraft Corporation.



AN AEROPLANE WITH A

There is quite a possibility that the Brewster fighter may, as shown in above *Flight* copyright drawing, be used for warding off attacks by Junkers dive bombers.



The Brewster aircraft with which we are concerned here is the type F2A, the first of which was designated XF2A-1 to denote its experimental character. This was built for the United States Navy as a shipboard deck-landing fighter. An order was placed for fifty-four of these machines, but when Finland urgently required fighters the Navy agreed to a diversion of most of these. Belgium also ordered some, and more recently Great Britain. One may assume that all these have now been, or will soon be, diverted to this country.

When the U.S. Navy waived its claim to the first batch, an improved version was in the offing, the main difference being that the Wright G-200 Cyclone engine was substituted for the earlier type. Changes were also made in the aeroplane itself, the most noticeable outward difference being the fitting of a larger fin. It is not known whether or not this country will be taking delivery of the latest version, but it is to be hoped that this may be the case, as the performance is bound to be a good deal better with the G-200.

In general design the Brewster XF2A-1 is a monoplane of the mid-wing type, the most unusual features of which are the very short and deep fuselage and the design of the

WITH A "BACKGROUND" (CONTINUED)

undercarriage, which retracts partly into the wing and partly into the fuselage. There is a tendency to regard this as a feature typical of Grumman aeroplanes and originated by that firm, initially for biplanes in which the wings are not thick enough to house the wheels. Actually, the scheme was used many years before the Grumman designers adopted it. At a Gordon Bennett race at Etampes in the 1920s there was a Wright monoplane which retracted the wheels into the fuselage, and our own Bristol company produced a racing monoplane with this feature at about the same time.

It may be a debatable point whether this arrangement is better than the more usual one for monoplanes (for biplanes it is the only practicable one). It does have the advantage of great strength, as the oleo leg, or leg carrying a sprung wheel, does not have to be cantilever, but is braced while in use. Moreover, the angle through which the leg has to move is approximately halved, 45 deg. against 90 deg., roughly. That it offers a good deal of drag during take-off is undeniable, and pilots report that the acceleration felt when the wheels go up is remarkable.

Orthodox Construction

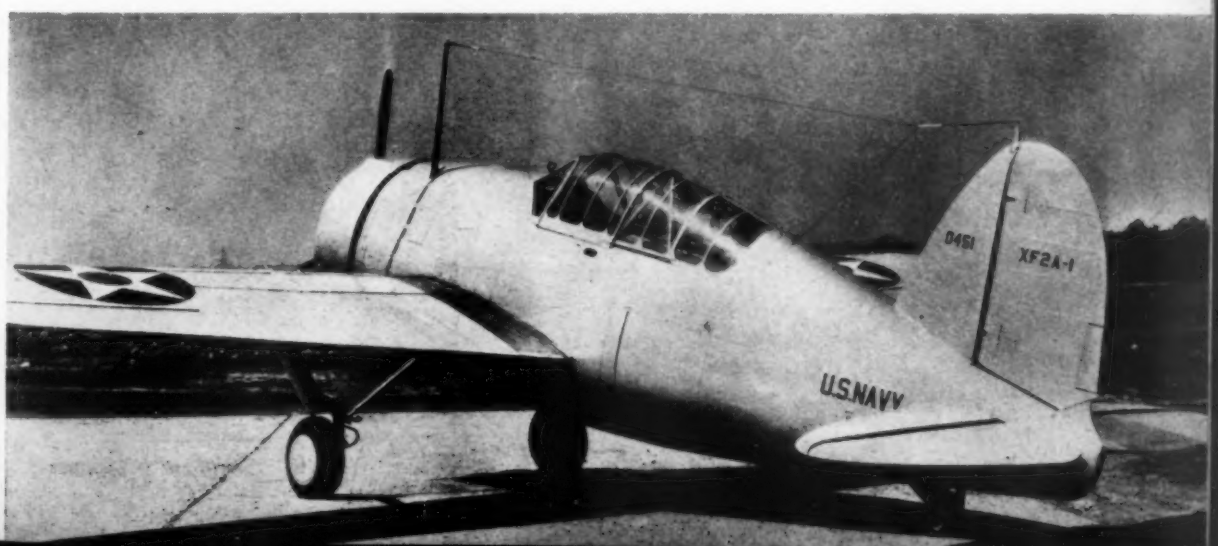
Constructionally, the Brewster is fairly orthodox in other respects, with stressed-skin construction generally employed except for movable control surfaces, which are fabric covered. An exception is formed by the trailing edge flaps, which have metal skin covering.

In size the Brewster is comparable with the Spitfire in that the wing span is roughly the same (35ft. compared with the 36ft. 10in. of the British fighter). No performance figures are available, but it is to be supposed that with the G-105 Cyclone the speed at operational height is something over 300 m.p.h. With the G-200 engine it should be in the neighbourhood of 330 m.p.h. Variable-pitch airscrews are fitted, and may be either Hamilton-Standards or Curtiss electrically operated to any pitch angle.

As built for the U.S. Navy, the armament included four machine guns or two machine guns and two shell-firing guns, the former housed in the deck fairing and firing through the airscrew disc, and the latter mounted in the wings, outside the undercarriage attachment. Deck landing equipment is incorporated.

From the fact that the machine was designed originally as a ship's fighter, the possibility exists of using it in the Fleet Air Arm, but it is not known if such is the intention. Finland and Belgium wanted land fighters.

Pilots have nicknamed the Brewster the "Peanut Special," or the "Flying Barrel." The undercarriage is unusual but very sturdy and accounts for the fuselage shape.



The Flying Wing

THE ESSENCE OF SPEED AND POWER . . . .
THE EMBODIMENT OF STRENGTH AND ENDURANCE

Cunliffe-Owen Aircraft Ltd.

DESIGNERS AND CONSTRUCTORS OF AIRCRAFT.

SOUTHAMPTON AIRPORT, ENGLAND — CONTRACTORS TO AIR MINISTRY.

EXPANDING U.S. PRODUCTION

Analytical Survey of the Task : 3,000 Aircraft per Month in Four Years

By BRUCE FOSTER, B.C.E., D.I.C., A.F.R.Ae.S.

LORD BEAVERBROOK'S broadcast statement that plans had been approved for the immediate expansion of the American aircraft industry up to a capacity of 3,000 per month is extremely important, and if such a flow of aeroplanes were available now, a decision would be reached in the war in a very short time. The words as used by Lord Beaverbrook, "to put into immediate production aeroplanes for our account up to a total output of 3,000 per month," may convey a wrong impression to some. Though we are receiving aeroplanes from America now and will continue to receive them at an ever-increasing rate, it will be some time—a long time—before the ships are pouring out Consolidateds, Douglases, Lockheeds, Grummans, Curtisses and Martins on to our wharves at the rate of 100 every day (with no let-up on Sundays).

Suppose there are 50 aircraft aboard each ship; that means two ships every day, rain or shine, rough weather or calm. One does not doubt the ability of the U.S. aircraft industry to reach such a rate, for her automotive factories have always shown production ability of a high order. But the factor with which we are vitally concerned—and of it Lord Beaverbrook gave us no indication at all—is the time required to work up to this 3,000 rate. Probably the production people in U.S.A. had not then worked out their estimates. As a preliminary to the time estimate it is the purpose of this article to give some idea of the magnitude of the task lying before the United States in the expansion of its present facilities on the enormous scale which will be needed. Some estimates of the time required will be discussed also.

The Present Facilities

There are 39 airframe factories in U.S.A., and for the purpose of making estimates all calculations will be based on these factories and their related figures. Not because they are more important than the engine, airscrew and accessory factories, but because they are the easiest part of the industry at which to apply the yardstick to measure production. The words "airframe factory" have been applied in this article to those factories in which airframes are made and fitted with engines, airscrews and all the accessories such as instruments, hydraulic systems and landing wheels which are made in other factories.

The table lists the 13 largest of these factories, whose total factory personnel (office, engineering and production) at April, 1940, exceeded 1,000.

The term "factory personnel" as used in this article needs definition. It has been used to include the three classes of labour: production, office and engineering. Production people are those engaged in the factory proper; office people include the accounting, advertising, sales, managerial and executive staffs; while engineering covers design, research, stress analysis, drafting and testing.

Investigating the relative proportions of labour in 14 American factories with total personnel ranging from under 100 to over 15,000 and covering a total of nearly 40,000 people, it is found that the average proportions are these: production, 74; office, 16; engineering, 10 per cent.

DATA ON LARGE U.S. AIRFRAME FACTORIES

Airframe factory	Employees at April, 1940	Employees at April, 1939	Floor area 1000s of sq. ft.	Backlog 1000s of dollars
Bell	1,150	1,000	210	7,500
Boeing	6,100	3,000	765	—
Brewster	1,500	—	188	—
Curtiss	5,000	3,500	665	—
Douglas	15,700	6,350	1,307	97,287
Lockheed	6,400	5,600	668	55,000
Martin	10,824	7,458	1,200	41,500
North American ...	5,025	2,490	720	51,000
Republic	1,650	245	200	15,000

Though exact figures for Consolidated, Grumman, Vought-Sikorsky and Vultee are not available, they would also qualify for this list.

Adding to these the figures for the remaining 26 factories* and making reasonable approximations to fill a few gaps for which the information could not be obtained, it is found that the employees for the 39 factories totalled 79,000 at April, 1940, and about 42,000 at April, 1939. This is an 88 per cent. expansion in one year, itself a very creditable increase, but, as will be shown, nothing like the order of increase required. Total floor space, including office as well as factory proper, approximated closely to 10 million sq. ft. at April, 1940.

(On the subject of floor space it may be of value to note that T. P. Wright subdivides factory space into workshop space, 83; office space, 17 per cent.)

How Much Expansion ?

Consider the Lockheed factory, whose personnel for 1939 may be averaged at 6,000. A Lockheed official statement showed that for the calendar year of 1939 they made 356 military or commercial aeroplanes, of which 290 were reconnaissance bombers (presumably Hudsons), 12 were light patrol, and 54 were commercial transports. This total is a rate of 30 per month, a small figure when we are talking of thousands per month, yet no one would accuse the Lockheed Company of being inefficient or of being a negligible figure in the aircraft world.

Of this production, 250 Hudsons went to Britain and their manufacture and delivery took twelve months. Even if unlimited credit is arranged, aircraft cannot be obtained just by giving the order, and the above example illustrates this forcibly. *Apropos* of finance, one wonders what significance should be attached to the comment of Mr. Morgenthau, Secretary of the U.S. Treasury, that there appeared to be no doubt about the ability of Britain to pay. Does it mean that the transaction is on a credit basis and that America will no longer insist on the "cash-and-carry" clause?

Total airframe factory personnel in U.S.A. may be averaged for 1939 at 60,000, and this labour force was able to turn out 5,856 aeroplanes of all types during the year, a monthly rate of 488. Of the 5,856, 2,141 were military and heavy commercial, while 3,715 were classed as other commercial aeroplanes.

The figure of 488 agrees with a statement by Mr. T. P. Wright, vice-president of engineering for the Curtiss-Wright Corporation in *Aviation* for July, placing current production rate at 500 per month at May, 1940.

So the expansion as far as personnel is concerned must be at least a 6-fold one to attain to the 3,000 rate.

It is obvious that an enormous task lies ahead for American industry. The expansion may be more than a 6-fold one since the 488 aircraft of mixed types are not equivalent to 488 military aeroplanes. In fact, the bulk of the 3,715 commercial aircraft are described as being in the "light 'plane class." But greater efficiency will result when bigger production batches are the order of the day, as they would be if production were greatly increased. Without more refined data a very close estimate is not possible, but to put the expansion at 8-fold is a not unreasonable figure. This implies an airframe factory personnel of 480,000.

Engine and airscrew factory personnel may be obtained by recourse to a ratio given by T. P. Wright, which shows that this figure is in the proportion of 21 to 79 when compared to airframe personnel. It should, therefore, be about 128,000, giving a total of 608,000 for airframe, engine and airscrew manufacture.

* The other 26 factories are: Aeronautical Corporation, Barkley-Grow, Beech, Bellanca, Cessna, Culver, Curtiss-Wright, Fairchild, Fleetwings, Harlow, Howard, Kellett Autogiro, Luscombe, Mononcoupe, Northrop, Piper, Porterfield, Rearwin, Ryan, Spartan, Stearman, Stinson, Taylorcraft, Timm, Vega, and Waco.

EXPANDING U.S. PRODUCTION (CONTINUED)

The greatest ratio of expansion will be in personnel, as every effort will, no doubt, be made to work three shifts so as to utilise to its fullest every square foot of space and every piece of plant. T. P. Wright's estimate of increase of floor space in the airframe factories to bring present production rate up to a rate of 4,200 per month (50,000 per year) is to multiply it by 4½. So, for a 3,000 rate, the increase is probably 4-fold.

The same figure applies to quantity, and therefore cost, of plant, since this is in general proportional to floor area.

Production and Export

To digress for a moment and investigate American production for 1939 a little more closely, it is found that all types for January, 1939, totalled 157, against 351 for January, 1940, an impressive increase. But this is somewhat deceptive, for monthly totals vary considerably during the year (between 380 and 70). But taking the first three months of the year against the last three months, the respective totals are 549 and 569, only a very small increase. It is apparent that, though personnel was on the increase, this cause had not made itself felt as an effect on the output at the end of 1939.

Exports, too, are interesting. Official American figures yield the following summaries:—

U.S.A. AIRCRAFT EXPORTS

	To France	To Britain	To Canada	Total U.S. exports to all countries
For 12 months of 1939 ...	457	462	68	1,445
Per month	38	38	6	120
For first 4 months of 1940	403	85	40	856
Per month	100	21	10	214
Total for 16 months ...	860	547	108	2,301

All this shows that American exports of aircraft are not great in volume when seen from the point of view of the astronomical figures required for war consumption. And U.S.A. before the war had the biggest export trade in aircraft, being in every world market.

It is very difficult to reconcile the figures given in the daily papers with these official export figures. A Reuter report in the *Daily Telegraph* of July 27 says that a spokesman of the British Purchasing Commission announced that 2,800 of the aeroplanes ordered by the Commission had been delivered. The export figures to the end of April, even including the Canadian number, only add up to 1,515. This leaves 1,300 to be accounted for in less than three months, a monthly total of about 450, which is greatly in excess of the 121 per month average for the first four months of this year.

The explanation may, perhaps, be in the interpretation of the words "delivered" and "exported." "Delivered" apparently does not mean "landed in England," as many people would think. It may mean "rolled out of the factory door and waiting crating and shipping." "Exported" probably means "actually left by ship," so that if there is an accumulation of about 1,000 aeroplanes finished but awaiting shipping, the statements would be reconciled.

Time Required for Expansion

Dealing now with the time which must inevitably elapse before the production rate reaches this great figure of 3,000, which towers as high above the present rate as an eight-storey city building above a cottage. In this connection it is only possible to quote the statements of well-informed technical Americans. Mr. W. S. Knudsen is the production head of the newly formed National Defence Commission, and before that was one of the biggest executives of General Motors. He said that the plan announced by Lord Beaverbrook would require the construction of 38 new factories for engines, parts, accessories and final assembly. He estimated that production at this rate could not be achieved before the middle of 1942; in other words, not less than two years from now.

Mr. T. P. Wright's view is more definite, and differs from the above. He says: "It is doubtful as to whether or not we can do better, since the energies of Germany were certainly concentrated to the utmost in arriving at the Air Force she now possesses. [He thinks that at July, 1940, Germany has a strength of 31,000 aeroplanes, and that production is 1,850 per month.—ED.] However, the gravity of the present situation and the complete backing of the country for the Programme, coupled with the magnificent general industrial development which we possess and the greater extent of our resources, may make possible some improvement over the rate of progress realised by the Germans.

"It is estimated that an airplane production rate of approximately 2,000 a month, or 24,000 a year, can be achieved in 2½ years, or by January, 1943; a rate of production of 3,000 planes a month, or 36,000 a year, can be attained in four years, or by the spring of 1944; and a rate of just over 4,000 planes a month, or 50,000 planes a year, can be realised in five years, or by July, 1945."

Mr. Wright knows his subject, and is the biggest engineering executive of the Curtiss-Wright Corporation, which has at least 6,000 men employed, so he is accustomed to making estimates involving large numbers of men, materials and machines engaged on aircraft work. Mr. Knudsen, too, has occupied a big executive position in the automobile world, but we have seen in this country that the estimates of such people about rates of aircraft production frequently tend to be optimistic. Mr. Wright's estimate should undoubtedly be given the greater weight, and he says four years from now for 3,000 per month. At this stage it should be remembered that the calculations in this article are based on the assumption that the total U.S. production rate is 3,000 per month, that being *the rate at which Britain desires to buy aircraft from her.* But what of her own military needs?—and her airline needs?—and her exports?

These will have to be supplied, too, and they are not small. President Roosevelt spoke about needing an air force of 50,000 aircraft and a yearly production rate of 50,000 (4,200 per month). The two rates if added would give the staggering total of 7,200 per month, with a few others, say 100, for commercial needs. Such a figure is no doubt impossible to attain under a decade.

The answer is, of course, that by the time the 3,000 is attained, the 4,200 rate may not be needed. In any case, it is so far off that it is beyond the range of strategical or even political forecasting.

Transatlantic Delivery

THREE of British Overseas Airways most experienced transoceanic pilots will soon be engaged on the delivery of bombers to this country from the United States and Canada. They are Captains Wilcockson, Bennett and Ross, and they arrived in Montreal on July 31 to start their job of "ferrying across the ditch" the various types which are being built for Britain over there. From the States will come the Consolidated 28-5 flying boats, Lockheed Hudsons, Douglas DB-7 and Martin 167 bombers, while Canada will supply the Handley Page Hampden and other British-designed and Canadian-built machines.

These three pilots have been taken over by the Ministry of Aircraft Production. Captain Wilcockson is well known as the head of the Atlantic division of the Corporation and made the three survey flights of 1937. As a pioneer of commercial aviation in this country, he has been identified with it ever since the days of the Handley Page Transport, Ltd.

Captain D. C. T. Bennett, an Australian, has made notable flights with *Mercury*, the upper component of the Mayo Composite, to South Africa, when he captured the long-distance record for seaplanes, and across the Atlantic to Montreal and New York. He is the author of the textbook, "The Complete Air Navigator."

Captain Ian Ross is a Canadian who joined Imperial Airways in 1936 and was destined to be engaged on Atlantic work this summer, if there had been a service. Before that he was with the R.A.F. in Egypt and Singapore, following several years spent on airline flying in the rougher parts of Canada.

Air Strategy—XIV

AIR BLOCKADE—IV

Its Value as a Weapon of War

By CAPTAIN NORMAN MACMILLAN, M.C., A.F.C.

THE Royal Air Force now has one great advantage over the *Luftwaffe* which has not been accorded the prominence it deserves. True, it has been customary to place on the credit side of the R.A.F. its superiority in aircraft and personnel as factors which diminish in some degree the value of the greater air strength of the German air force. But now that the war has entered the fourth phase in less than twelve months, it is only fair to credit Britain with yet another factor which offsets the German numerical advantage in aircraft. The new factor has been introduced by the initiation of air blockade on an increased scale by both sides. It is this: Germany has to use her air weapon as a means towards the blockade of both sea and land, but the efficient sea blockade applied by the British Navy enables the R.A.F. to devote a relatively larger part of its energies to the purpose of land blockade operations.

It is not true (as some people appear to think) that this advantage to Britain is nullified by the fact that Britain alone now opposes Germany and Italy, and that this restriction in our bases for operations enables Germany to turn all her air strength against Great Britain. But it is fair to say that the whole situation needs re-examination in the light of new developments among both belligerent and non-belligerent nations.

One Front

Germany's method was made clear by Hitler in his writings, in his promises to his generals, and in his methods of conducting the war. It is to fight a war of one front at one time. Is that the reason why the threatened attack upon the British Isles has been delayed? Must Hitler first solve the Balkan issue (which he shelved when he turned upon Holland and Belgium) before he can hope to attack Great Britain? Or some other issue, perhaps?

The German policy of fighting on one front only at one time is sound. It follows the military axiom of concentration of force. But, to be achieved successfully, it requires an exceptionally neat dovetailing of the political as well as the military factors involved. In this aspect of their plans for world domination the Nazis have been clever political strategists. But will they be so clever in consolidating the positions that they have won in Czechoslovakia, Poland, Norway, Denmark, Holland, Belgium, France? I doubt it. The German political genius is an infinite capacity for taking pains; but that does not imbue it with the attributes needed to gain the good will of peoples whose countries they have overrun, and about whose streets the heavy boots of the German soldiers stamp.

The continuation of the German plans is evident in world affairs among those peoples who are still outside the periphery of the German ring of steel. That is, no doubt, why Japan has been stirred up against Great Britain. What better antidote could there be to the possibility of leanings towards the British in the Near East? And if Russia's attitude towards Germany is not as satisfactory to Hitler as he would wish it to be, anti-British demonstrations in Japan represent a pretty good come-back.

And in the Japanese attitude to-day, the employment of the standard Hitlerian methods is again evident. One front for Hitler, two for his foe. So it was in Norway, where simultaneous attacks were delivered against ports on the Atlantic seaboard and against the ports on the Cattegat side of the country. Poland was crushed between two fronts. Holland fell the same way, by the employment of troops dropped and landed from the air. France crumbled under the same tactics.

Dividing Our Defence?

Can these methods be applied against Great Britain? Will Hitler try to bleed the strength of the defences of these islands by endeavouring to create such a situation as will tempt us to despatch big forces elsewhere, as will try the patience of the Admiralty? If so, where and how will he make the attempt?

Italy cannot make a serious move unless strengthened by Germany. Yet Germany will require all her strength to deal with Great Britain, and I have always held that the British Empire cannot be defeated unless the British Isles succumb. That I believe still to be true. But I do not believe that even the surrender (a laughable term) of Britain in the wake of France would now mean the defeat of the British Commonwealth.

Even such a catastrophe would represent but the first phase of a mighty campaign, or perhaps the last; but certainly it would not represent the only phase of such a campaign. So whether Italy makes the move with German backing or whether Germany makes the move with Italian backing, that move is not enough. Hence Japan, primed these past five years with propaganda of the Nazi pattern—including all the arguments against the Jews—and fired in any case by her own brand of Imperial Nationalism which springs from the Shinto religion, falls readily into line with the Hitler plan. It suits Hitler, but perhaps it suits Japan better. Either way, it doesn't suit us, at the moment, and Hitler knows it; it constitutes his double front move against us.

But his move will fail. What then? Spain? and through Spain, whither? Will he try to draw us down to the Mediterranean? Or will he stake all in one colossal blow at Britain, when he realises that Britain refuses to be drawn by any of his feints? Part of his art is to keep his opponent guessing. It is easier to achieve success with secrecy under a regime where heads with careless tongues are just chopped off.

The Second Front

Now, quite obviously, it is important to consider the possible second front and to guard against a devastating blow coming from it. It is equally disastrous to be stabbed in the back or to be kicked in the belly; to suffer both at the same time is an unnecessary tragedy.

Japan alone could not confront the British Empire. Nor could Germany. Nor Italy. But now all three confront us, with Japan not yet at war. While Spain's policy of non-belligerency is unhappily like the policy of Italy before she came in, vulture-like, at the death of France.

In the Far East, while we have followed a policy of appeasement with Japan over the Burma Road, only

AIR BLOCKADE (CONTINUED)

to fall into the "losing-face" predicament of the arrested Britons, while Japan has sent out pourparlers to Australia. In the Mediterranean and Middle East we have conducted a kind of hide-and-seek war with Italy at sea, on land and in the air. In Western Europe we have concentrated, against Germany, our main defences in these islands, which are the heart of the Empire. As the Prime Minister said in his last broadcast, "Never in our history have we been so strong, here, in Britain." And daily and nightly the Royal Air Force takes toll of German strength by attacks against harbours, oil storage depots, oil refineries, synthetic oil plants, railways, canals, factories and all the manifold targets which to-day are military targets in the fullest sense of the word.

Germany the Foe

There is no doubt, no doubt at all, that we regard Germany as the fountain head of the miseries which have to-day descended upon the Western World, however much Japan may be the transgressor in the Far East. And it is obvious that the Western World must be made clean before the process can go farther.

So Germany is our foe. And all our strength must, and will, certainly be directed against her. All other issues are side issues.

It seems that there were many who missed Mr. Churchill's last broadcast, in which he said, quite baldly, that it would be 1942 before we were ready to take the offensive. That is at the least 17 months. But as offensives are not usually begun in winter, it is more likely to be 21 months. That statement apparently envisages the offensive as a campaign in which troops will be landed upon the soil of the Continent of Europe to grapple with the German armies once again on historic battlefields.

If that be the interpretation to put correctly upon the words of the Prime Minister, then his words can be gauged as weighted with the sagacity in which his utterances are couched. But if that was what he meant, then, I, with all circumspection for his greater sources of information, do not agree with what he said. For what he said applies only to the Army. It does not apply to the Navy, still less to the Royal Air Force. It is true that the Army is on the defensive. But that is not so either at sea or in the air.

The toll of German aircraft in the first eleven months of the war is greater than the combined first-line strengths of all the Allied air forces which have been arrayed against Germany since Poland was attacked. Is that an offensive or a defensive war in the air? The Navy is now stronger *vis-à-vis* Germany than it was when war began; the entry of Italy into the war has but clarified a formerly smoke-screened position. It has not seriously altered the naval preponderance against Germany. It has not affected Britain's ability to blockade by sea the whole of Europe; rather has it strengthened Britain's power in this respect; there is now no need for scruple over the niceties of the "we-are-not-at-wars." Italy may have stuck her knife into France, but already she must have begun to rue that feeble conquest. There is an Italian saying, "Dolce far niente," which, being very freely interpreted, may be transcribed as "It's sweet to do nothing." Well, the barley sugar that Italy sucked over France will turn to bitter aloes before this war is done.

What Britain needs to-day is range in bombers. And more range. Those we have are good. Or, rather, should I say some of them? I don't think some of our bomber classes are all they might be. For example, those primarily designed for work in close co-operation with the Army. What we principally require to-day are fast, long-range heavy bombers whose bomb and fuel loads are largely interchangeable.

To be one hundred per cent. efficient an air force must be able to reach all its targets. When it can reach only some targets it gives the enemy the opportunity to withdraw important elements of national defence into safe areas.

Good as the aircraft of the Royal Air Force are to-day, they are not good enough. Greater range is needed. For, now, we have no advanced landing grounds on the mainland of Europe. The targets we desire to attack must be attacked from bases within Great Britain, or from British aerodromes in and about the Mediterranean, or from aircraft carriers. And, be it noted that the aircraft carrier method does not help us much in the present situation. The distance Fleet Air Arm aircraft can save by operating from their floating aerodromes does not enable them to attack major targets outside the range of shore-based bombers, but only minor targets. And by the major targets I mean the great industrial hinterlands of Germany and Italy.

Strategical Targets

So, while we are maintaining an air offensive against the German air force, and against targets in the western half of Germany, there are targets in Germany against which we are not directing attacks as we ought to be directing them. One such target is the great cloth-producing belt of Germany. It must help to reduce the fighting power of an enemy to cut down his output of uniforms, civilian clothing and stores of fuel, all of which (like food) produce warmth to the body. Yet the Silesian coalfields have not been attacked. Nor has the great centralised clothing manufacturing area which lies to the eastward of Berlin.

One is apt to take certain things in one's own country for granted, and forget that in all probability a similar situation exists in other countries. We associate Lancashire with cotton and Northampton with boots automatically, Bradford with woollens and Sheffield with steel. But we forget that Germany must have a similar geographical delimitation. Or more probably it is not a case of forgetting at all, but simply because we never had to bother, we don't know.

Now soldiers (and by soldiers I mean the generic term which embraces all professional fighting men of land, sea and air) in my experience know mighty little about the commercial side of anything. It's not their job. Their job is to run their ships, their tanks, their guns, their platoons, their squadrons efficiently in the light of the eyes of the chief under whom they serve for the time being (and ten to one he, like all of us, is a crank in some respect); they must, by the very nature of their calling, live up to the notions of the chief they serve. And in war, soldiers (again the generic, please) get the upper hand. They move about in uniform, a thing which is considered wrong in peace-time, and everyone looks up to them as the saviours of their country, all conveniently forgetting what terrific taxes we have to pay to keep them. Well, now, I'm going to commit a heresy. There isn't a soldier who knows how to win a war except by the bow and arrow method—which is that the chieftain who commands the most bows and arrows wins. And that is true of

AIR BLOCKADE (CONTINUED)

soldiers whether they fight in khaki, light blue or navy blue. And the curse of the matter is that the men who know the commercial side of the enemy's power, his purse, his larder, his factories, his workers, his psychology, his revolutionary tendencies are right down at the bottom of the picture where the humble artist usually signs his name.

We have our Ministry of Economic Warfare, and all the rest of the standard systems of old brought up to date. But what power have they got over the actual operations of the fighting Services? Can they demand that certain targets must be attacked? Can they demand that if for technical reasons such targets cannot be attacked an immediate inquiry should be held into the reasons why the target is out of range, temporarily, and for how long? Can they demand that the Service concerned must lay down the specifications and expedite the building of the requisite types of aircraft to enable the Ministry of Economic Warfare to wage economic war by the employment of aircraft for land blockade? Or is the Ministry of Economic Warfare a withholding device which employs only the power of sea blockade? If it has power to employ the latter method only it is not enough.

The whole policy of Britain's blockade of Germany should be a co-ordinated policy. It should embrace the power which sea supremacy offers of preventing supplies from reaching the enemy by sea. But at the same time it should have the power to request that stores which have reached the enemy by other routes shall be destroyed by air action; it should have the power to state which are the main targets that must be attacked in enemy territory to prosecute the economic war by the dual means of strangulation and destruction.

How much authority has the economic war department got over the employment of the air force? What co-ordination exists between the employment of the Navy and the R.A.F. in regard to a combined blockade? And to what extent does the financial method of strangulation of enemy supplies dovetail into the sea and air operations?

All soldiers (generic term) tend to attack their kind, or to destroy the main sources of power which may be used against them. That is natural. But in concentrating effort in that way, the opportunity of taking action against the vital sources of power of a modern nation may be lost.

And so, to-day, with the major part of our resources concentrated in Great Britain, we need not wait until 1942 to take the offensive. With a fully co-ordinated campaign of sea, air and financial blockade we ought to be able to drive German industry eastwards and by adopting clever tactics make it concentrate in what are at the moment safe areas, only to receive the full blast of the power of the longer range aircraft which must be produced to enable the weapon of air blockade to be applied to its full extent.

VISIBLE VORTICES

Numerous Readers Record their Observations

PERHAPS you would be interested in a new type of smoke trail.

My breakfast on July 22nd was rudely and unmannerly interrupted by a bomb explosion, followed by gunfire. On going outside, I could see shrapnel smoke of a greyish-black colour instead of the usual white. A little later, at about 20,000 feet, and just under the cloud banks, as the bursts came near a long smoke trail of the same colour as the shrapnel smoke streamed back, fanwise, from each engine. It stopped, then restarted again, and the machine disappeared into the clouds. This was observed in detail by my uncle, who had field glasses.

We concluded that it was a ruse to make the gunners think that the aeroplane was on fire. I have seen white smoke trails from a Hurricane zooming at 2,000 feet, but this was of different shade and shape.

Fareham. A. McKEE.

I WAS extremely interested in your article on "Visible Vortices" in *Flight* of July 18th.

Like other readers, I, too, have been fortunate in observing these plumes of white cloud which occasionally appear when aircraft are flying high.

About three weeks ago I saw an air-battle taking place over the coast following a raid on a south-coast town. There were several enemy bombers in formation which were obviously being attacked by our fighters. They were flying at a great height, probably 15,000 feet or more, and the bombers, which could just be seen, were leaving a straight trail of white cloud behind them. On the other hand, the fighters, which were hardly visible, could only be detected by the presence of these "trailers" which passed underneath and round the enemy planes as if dive attacks were being made. This seems to rule out the possibility that the cloud is "specially manufactured," since it was observed behind both our own and enemy planes at the same time.

Again, recently I was walking in the country and stopped to watch three Blenheim long-nose fighters chasing each other about the sky and performing some very tight turns. One of them passed immediately overhead at not more than 3,000 feet, probably less, and, at the point where it made an extremely tight turn, these white plumes appeared at the wing-tips but ceased as soon as the plane straightened out. Unlike the previous occasion when the aircraft were flying high, the streamers condensed and disappeared immediately.

On both of these occasions the weather was almost perfect with practically no wind and very little cloud.

Up to the present I have been uncertain as to whether the cloud formation was caused by the airscrew or the wing-tips, but in my second experience I was quite certain that it came from the latter.

Chichester. MURRAY SMITH.

THE article in *Flight* of July 18th and the correspondence in your issue of July 25th prompts me to encroach on your space to suggest the following causes for the formation of the cloud trails created by aircraft flying at a considerable height under certain atmospheric conditions.

I have noticed these trails in the making on three or four occasions since the outbreak of war and assume that the reason for their not being observed prior to September, 1939, was due to the extreme rarity of flights at 25,000 feet and over.

I believe the explanation is related to the phenomenon of aircraft icing in that it is due to the *freezing* of very minute particles of supercooled moisture. By a combination of certain meteorological conditions, an invisible strata of this supercooled moisture or water vapour may be present at an altitude where the temperature is not only very considerably below the dew-point but also below freezing; owing to the effect of surface tension and probably the entire absence of any nuclei on which to condense, together with the fact that the water vapour has remained completely undisturbed, it neither condenses nor freezes.

The passage of an aeroplane through this strata creates considerable disturbance both in the form of turbulence and sound waves, whilst the engine exhausts provide innumerable particles of water to serve as condensation nuclei. The supersaturated and supercooled water vapour immediately starts to condense and thereupon freezes in the shape of countless ice crystals, exactly corresponding to a Cirrus cloud. The visible

VISIBLE VORTICES (CONTINUED)

vortices or "smoke trails" seen recently are consequently merely elongated Cirrus clouds.

Some readers may recall the school laboratory experiment of cooling a saturated solution of some salt in a glass beaker which on being lightly tapped immediately crystallised. It is the disturbance and, I suggest, the noise created by the passage of the aircraft which is responsible for the formation of the Cirrus cloud. In fact, one of the investigators into the aircraft de-icing problem suggested the generation of a powerful sound wave directed ahead of the aeroplane as a means of causing the supercooled moisture to freeze before reaching the wing leading-edge and thereby prevent freezing and ice accretion on the wing itself, although this original solution of the problem unfortunately proved to be sounder in theory than in application.

A point in support of the foregoing explanation is the fact that the diameter of these cloud trails is obviously many times greater than the wing span of the aircraft responsible for them.

London, S.W.1. A. R. OGSTON, F.Inst.Pet.

ON the afternoon of July 26 the atmospheric conditions over this village were becoming suitable for the formation of vortices by aeroplanes, and one or two short ones were visible. The weather looked thundery with very big cumulous clouds and fleecier ones between them, and I have quite often noticed vortex streamers on similar days. The vortices were similar to the diagram on page 51 of *Flight* for July 18.

About 1 a.m. this morning, the 27th, we had a number of enemy machines over us at great height and long vortices (many miles) were easily visible to the naked eye, and the evolutions of the machines could be followed.

The streamers were lighted up by the moon, but the searchlights also played on them, and one or two operators quickly tumbled to the idea of moving their beams until they cut across a streamer and then following it along quickly until the machine causing it was caught up and held in the beam.

The weather conditions were still thundery and lightning was playing now and again.

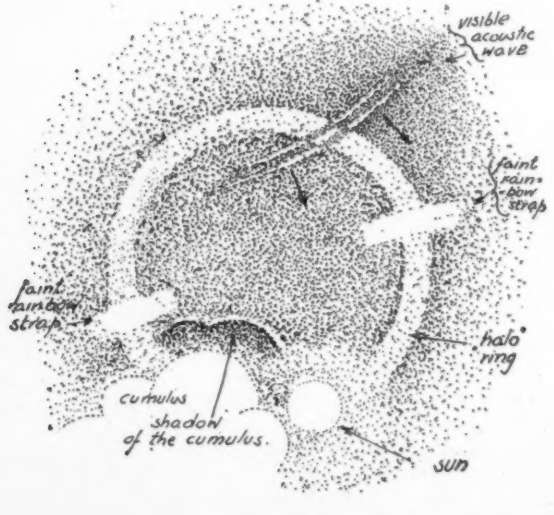
I thought these particulars might interest you.

Blandford, Dorset. G. LEE EVANS.

FLIGHT has given us some interesting observations about the visible vortices. This phenomenon is well known to the Polish pilots of the PZL 11 fighter plane When pulling out from a dive, or making a steep turn at a high speed, two white vortices streaming from the ailerons and wing-tips were very often distinctly visible, and Polish fighters used to say that the fight was going on "with foam streaming from both planes."

I had a chance to observe a very interesting phenomenon of similar nature, which I would like to communicate to *Flight* readers.

On the afternoon of March 7th, 1940, "somewhere on the English coast," the sky was covered with a very thin and very low layer of stratus. This layer was transparent and its presence was evident by a shadow thrown on its surface by a Cumulus and a very large "halo" ring. This "halo" ring was cut in the diameter by two bright straps of very faint rainbow.



Some miles away there was heavy artillery shooting. Before each detonation something like greyish lines appeared on the circumference of the halo ring, travelling with an even and high speed towards the diameter of the halo ring and disappearing in the vicinity of the rainbow straps. Their high speed, even propagation and coincidence with the detonation which followed afterwards, were a proof that we had visible acoustic waves under observation.

My primitive diagram gives an idea of what this visible propagation of acoustic waves looked like.

The visibility of these waves on the "halo" ring can only be explained because of the changed refraction conditions, caused by the pressure wave. The wave travelled everywhere on the sky, but was visible only there, where the refraction took place, i.e., on the "halo" ring.

Polish Units, R.A.F. B. S.

SUNDAY, July 28, time 5.30 p.m. Across sky from Hartlepools at angle, say, 45 degrees. Towards Cumberland county there were plainly visible to the naked eye three distinct vortices parallel all the way, coming from out of Cumulus clouds. Remember we are in the St. Swithin's Day period. These clouds are generally from 30 to 45 feet in thickness and are always very close to the earth. Due to the natural (unknown) gravity which exists above them, fast-flying or heavily loaded aircraft always leave these marks, especially in a clear sky.

I also disagree with a remark from a reader airman that people cannot distinguish the difference between an enemy aircraft and one of British manufacture. It has been proved here, without knowledge of class or petrol in use! I may also say that a Topophone was not in use at this time.

Wallsend-on-Tyne. JOHN G. LAWS.

DURING March or April of this year, while serving as a height-finder in an A.A. battery, one of my instrument numbers and myself spotted an aircraft making a white visible trail in the sky. So far as I can remember neither he nor I could see the plane with the naked eye although his vision was extremely acute. We laid the instrument on and took some cuts which came consistently to 30,000ft. It was a Hurricane and the black and white marking was plainly visible at mag. 25 in the instrument.

From this I should estimate that the plane mentioned on Sunday afternoon, July 7, which I, too, observed from N.W. London, was flying at about the same height. Surely at 30,000ft. the fall in temperature with increase of altitude would be so large that the white trail was ice rather than fog.

There must be plenty of other height-finders who have observed this phenomenon. They could soon say if they saw two trails, i.e., one from each engine exhaust pipe, which would disprove the interesting vortex theory, since it would indicate that the trail was simply caused by condensation of water vapour in the exhaust gases on the necessary particles of solid matter also from the exhaust gases.

Ash Green. A. O. EDWARDS.

MAY I suggest another explanation for these white "smoke trails" formed by aircraft flying at considerable heights under certain atmospheric conditions? At these heights clouds are probably formed largely of ice crystals. The chemist is familiar with the condition known as "supersaturated solution" in which a liquid holds in solution a greater quantity of a solid than should be theoretically possible at that solution temperature and pressure. Provided such a supersaturated solution remains undisturbed, it will contain liquid, but if a small particle of the solid or even of dust is dropped into, it immediately crystallises out. May it not be possible that under certain conditions of temperature and pressure the atmosphere may contain water in a supersaturated condition, without such water actually crystallising out as ice crystals? The passage of an aeroplane through such a position of the atmosphere may provide first the disturbance, particularly in the low-pressure parts of the propeller or wing-tip vortices to initiate the crystallisation and form of trail of ice crystals or of water particles. Recently three Hurricanes passed over my house at a height of about 14,000ft. All three were forming trails, but these were not continuous. At intervals they passed through a patch of air where conditions were unsuitable and so no trail was formed. Two of the trails were *double*, i.e., wing-tip trails. The other machine was making a single trail—i.e., propeller vortex trail. This machine appeared to be flying slightly lower than the other two.

Sussex. G. M. PART.

"BOOST"

Long-distance Flying and the Take-off Problem

By F. W. LANCHESTER, LL.D., F.R.S.

THE writer dealt with the theory of long-distance flying in an article contributed to the columns of *Engineering* last year.* In that article the question of take-off was not considered, as it is, in the writer's opinion, a matter which should be regarded as a separate problem. The aeronautical designer and constructor has, perforce, to deal with both problems, not only as concerns the machine, but also the flight ground or, more generally, the take-off and landing conditions which the aeroplane may have to negotiate.

But to achieve the maximum range of flight possible, performance in the air must not be compromised by defective provision on the ground. The machine must be designed for maximum performance, and the task of getting it into the air must be treated as a separate problem.

Whether it be for ocean transport or for bombing raids, it is essential that the normal speed of flight shall be that at which the direct resistance and the induced drag are approximately equal to one another; it is then that the total drag is least. There is nothing to prevent such a machine from being flown at a greater speed in emergency, but the possible range of flight will then be reduced. This was set forth very clearly in the writer's "Aerodynamics" † in 1907, but in official quarters it has only been very tardily recognised.‡

Designing for Take-off

The present practice is to design machines to be capable of taking off from the limited length of runways available, and when in the air fly them very much above their speed of least drag. To such an extent is this the case that some designers consider that the induced drag may be ignored and the total drag computed from the direct resistance.

The problem of take-off as presented to us now is that of getting a machine into the air which has been designed to fly at a speed equal to present-day demands under the condition of minimum drag.

Broadly stated, there are three possible solutions to the problem of taking off under the conditions visualised. First, the provision of an aerodrome or flight ground of sufficient extent and area to allow of the necessary ground speed to be developed by normal means. Secondly, means for giving an artificial "boost" to the take-off. Thirdly, the launching of the aeroplane from a "mother ship," as in the Short-Mayo Composite Aircraft. Beyond this, in order to reduce the load and so facilitate the take-off, the system of fuelling in the air may be adopted; this, however, is an amelioration rather than a solution.

The first of the expedients given is that most favoured by the writer. It is his view that the flight ground has always lagged behind the needs of the day, and he believes that this is still the case. The aerodromes of to-day would nicely accommodate the aeroplanes of twenty years ago; and if we could have the aerodrome of the future, perhaps that of twenty years hence, from which to fly present-day machines, things would be no less satisfactory. The writer regards the position as in some respects analogous to that which obtained in the motoring world some 35 years ago; he was then never tired of saying that it would be well if a little of the attention then being devoted to chassis construction and suspension could be devoted to road improvement; that eventually came about. If the motor car designer of to-day, who is inclined to be a little scornful of the work of the pioneers, could see his products tested on roads such as we had in the old days, he would "sing a different tune."

Length of Run

If, on a calm day, when there is no wind to assist the pilot in getting off, it is deemed necessary to achieve a velocity of 150 m.p.h. = 220 ft./sec. before rising, the length of run even under the most favourable conditions is formidable. The actual acceleration will diminish as the speed on the ground increases, owing to the gradually rising air resistance or drag, and also on account of the fact that the initial acceleration is obtained with the variable-pitch propeller being made to function with a reduced pitch. It would seem that a mean acceleration for the whole run might be fairly taken as 4 ft./sec. per sec. Then the length of runway necessary to attain the take-off speed specified will be given by the expression $s = V^2/2f$, or,

$$\text{Length of runway } s = \frac{220^2}{8} = 6{,}050 \text{ ft. net.}$$

To provide for this, at least a mile and a half should be allowed, and in order to allow for the needs of military operations, the writer would be inclined to specify a flight ground of not less than 2 or 2½ miles diameter with a surface equal to that of a first-class high road (an area of about 3,000 acres). This need not be an aerodrome in the full sense, but rather a refuelling station for long-distance take-off only. The fuel tanks would be underground at bomb-proof depth, and, there being no set positions for the runways, a few bomb craters more or less would not materially affect the use of the ground; they could be dodged in most cases. The cost would be great, but in terms of war expenditure not prohibitive: two millions sterling would probably cover the cost.

Increased Acceleration

Some day we may see flight grounds of a size worthy of the modern aeroplane, but in the meantime the problem is to make the best use of what we have, and clearly what is needed is some assisted method of take-off. Acceleration is wanted far in excess of that which may be obtained from the engines and propellers unaided, even with supercompression and a variable-pitch propeller; in brief, a "boost" of some kind is necessary.

The choice of means is limited; we are not here considering the launching of a machine from a "mother ship" or refuelling in the air; these are solutions foreign to the major problem which fall into another category altogether.

Firstly, there is the catapult, used by the writer for the launching of high-velocity models in 1894,* and by the Wright brothers in full-scale experiment in or about

* *Engineering*, August 18, 1939, p. 203, and August 25, p. 217. See also October 13, p. 403.

† *Aerial Flight* (Lanchester), Vol. I, Fig. 112, p. 254. Also Prop. I, p. 235, and further reference, p. 143.

‡ *Journal of the Royal Aeronautical Society*, February, 1937. Contribution to the discussion by Mr. E. F. Relf, pp. 113 *et seq.*, and p. 124.

* *Aerial Flight*, Vol. II, p. 25, Fig. 21.

1906-08, and widely used to-day for launching aircraft from vessels at sea. Secondly, there is the rocket, which has been proposed more than once, but, so far as the writer's knowledge goes, has never gone beyond the experimental stage.

It is necessary at the outset to make some assumptions in the matter of data, and we shall take it that a velocity of 150 m.p.h. (=220ft./sec.) is necessary before leaving the ground. It will be further assumed that the effective length of the runway available is limited to half a mile, say 2,500 ft., and that there is no wind to assist the pilot in getting off. Then the time required is determined by the expression, $t = 2s/V = 5{,}000/220 = 22.7$ seconds. And the acceleration $= 220/22.7 = 9.7$ ft./sec. per sec. This is the value assuming acceleration uniform.

The Catapult

Taking first the catapult. For the duty in question it may be assumed that the minimum machine would be one of ten tons gross weight, and this gives the mean force required approximately one ton, of which not more than half (if that) could be furnished by the engines and propellers. The catapult, therefore, would need to supply a mean force of half-a-ton through a distance of 2,500 feet, or in terms of energy give nearly 3 million foot-pounds. There appears to be no prospect of a solution in this direction.

Next comes the proposal to employ a rocket.* This, to the writer, is no new problem; in the year 1895 he conducted experiments with a view to the adoption of a rocket in the propulsion of high-velocity models, not merely for the take-off. Instead of doing what now seems obviously the right thing and procuring a rocket from Brock or some other experienced maker, the writer, realising the importance of using high pressure, constructed rockets in which the case was a steel tube, and used compositions containing various proportions of black powder. Mostly his experiments terminated with an explosion, the case being rent; the dial readings were observed through a telescope from a safe distance; in this the writer was lucky in that "luck" is commonly a product of foresight!

In approaching this problem it is assumed that the pressure within the rocket case is constant, so that the recoil which provides the force of acceleration is constant.

It simplifies the problem to deal with the "boost" as constituting the only source of acceleration; the truth is not sacrificed; we are merely regarding the mass of the aeroplane as divided into two parts—that which is accelerated by the engines and propellers and that which is accelerated by the "boost." It is convenient to take *one ton* of boost as the basis of calculation, assuming ten tons as that portion of the mass which is accelerated by the boost. Then the total mass of the machine will be ten tons *plus* a mass to which the engine is capable of imparting a similar acceleration, and this will depend upon the extent of reserve power as determined by the degree of supercharge available and the use of a variable pitch propeller.

Let F = force in *poundals*. $F = 2{,}240 \times 32.2 = 72{,}000$. And $F = v(m/s)$, where v is the efflux velocity of the gases and (m/s) mass per second. The total time the rocket is in action is 22.7 seconds as given above, and if M be the total mass of the combustible charge, $(m/s) = M/22.7$; hence, $F = vM/22.7$.

The writer has no positive information on which the maximum efflux velocity may be assessed. Obviously the higher the better, for in the equation just given the higher the value of v the lower the total quantity (mass) of combustible will be needed. It will be provisionally assumed that 5,000 ft./sec. is a figure that may be safely reached. Then $F = 5{,}000\ M/22.7 = 220\ M$ poundals $= 6.8\ M$ pounds. And F taken at one ton = 2,240 pounds. Hence $M = 2{,}240/6.8 = 328$ lb. This is by no means unreasonable; it does not represent added weight, since it is all disposed of (consumed) at the instant of take-off. Moreover, in comparison with the gross weight at the time of acceleration, it scarcely need to be taken into account.

Efficiency

On the basis of the rocket equation, Efficiency $= 2V/v$; the efficiency at the word "go," when V is zero, is also zero, as indeed is otherwise obvious. At the end of the run, when about to rise from the ground, $V = 220$ ft./sec. and the efficiency is $440/5{,}000 = 0.088$. The mean value must lie between these limits. The total efflux energy when combustion is complete is $Mv^2/2 = 25{,}000{,}000\ M/2 = 12{,}500{,}000\ M$ foot-poundals ($= 388{,}000\ M$ foot-pounds). The work done usefully in propulsion is, $2{,}500\ F = 2{,}500 \times 220\ M = 550{,}000\ M$ foot-poundals. Hence, Efficiency $= \frac{550}{12{,}500} = 0.044$, which, as might be expected, is the arithmetic mean between the limiting values.

As a check on the foregoing, especially as concerns the efflux velocity assumed (5,000 ft./sec.), a comparison may be instituted between the efflux energy and the total fuel energy of the charge. As near as the writer can estimate, the latter may be represented by a figure 1,000,000 foot-pounds per lb. of composition. The efflux energy *per lb.* (as calculated above) is 388,000 foot-pounds. This gives the *thermal efficiency* of the rocket, considered as an internal combustion engine $= \frac{388}{1{,}000} = 38.8$ per cent., which is probably near the truth. At least it is not unreasonable.

* Suggested by the Editor as a fitting subject for investigation.

National Defense Advisory Commission

PRESIDENT ROOSEVELT has formed the National Defense Advisory Commission to plan and co-ordinate the U.S. defence effort. W. S. Knudsen, an executive of General Motors, is in charge of production, and has on his staff Dr. George Mead, a vice-president of the United Aircraft Corporation, to deal with aviation matters. Dr. Vannevar Bush, chairman of the N.A.C.A., will lead the research division.

Dr. Mead has appointed as his two advisors on aircraft and engines respectively T. P. Wright (of Curtiss-Wright Corporation) and Prof. E. S. Taylor, of the Massachusetts Institute of Technology. S. Paul Johnston, a former editor of *Aviation* and co-ordinator of research for the N.A.C.A., is executive officer.

Numerous other well-known names appear in the appointments, including Drs. von Karman, Millikan and Lombard, all of the California Institute of Technology.

The first work of the Commission will be to standardise on types of aircraft engines. For the over-1,000 h.p. size, two air-cooled radial and two liquid-cooled will be selected. Wright and Pratt and Whitney are likely to provide the air-cooled, while Allison, going slowly into production in the hands of General Motors, is a likely liquid-cooled design. The second liquid-cooled may be the Rolls-Royce Merlin.

Wing Testing

AN improvement on the old method of static testing by loading with sandbags or lead is to use hydraulic jacks applied at various points. By suitable linkages it is possible to keep the appled loads in a constant ratio while increasing them up to any desired figure. The Lockheed engineering department has developed a refinement to this method by designing low-friction jacks and making an autographic record of the deflections of the structure at as many as 50 points by means of wires operating pencils on a single sheet of paper. By studying the curves it is possible to forecast the next probable point of failure.

HERE and THERE

Lord Beaverbrook in War Cabinet

ON August 2 it was announced from No. 10, Downing Street, that the Prime Minister had invited Lord Beaverbrook, Minister for Aircraft Production, to become a member of the War Cabinet. It was added that, for the time being, he would continue to be M.A.P.

Well-known Pilot Killed

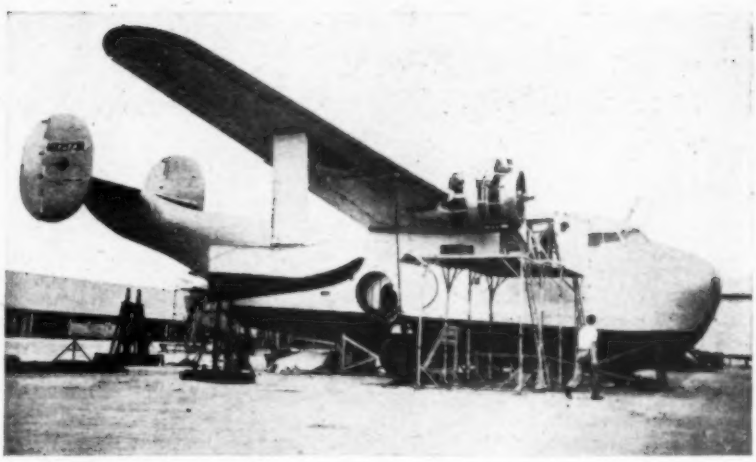
IT is with extreme regret that we have to announce the death in a flying accident of P/O. R. O. Shuttleworth. Mr. Shuttleworth was a noted racing motorist and aviator, and was chairman of Railton Cars, Ltd. One of his hobbies was the collection and repair of early types of aeroplanes, and his Bleriot and Deperdussin monoplanes were often seen performing at flying meetings.

No More U.S. Petrol

PRESIDENT ROOSEVELT'S order that no more aviation petrol may be exported from the United States except to countries in the Western hemisphere is likely to have far-reaching results. While it will obviously hit this country, it is thought that Germany will suffer to an even greater extent, as we have other sources of supply. Germany, on the other hand, will be cut off from the considerable quantities which reached her through Italy and Spain. Japan also will suffer, and has received the ban with strong disfavour. So far as the Empire is concerned, it should be remembered that Canada is in the Western hemisphere.

Atlantic Flights Resumed

DURING the week-end the Short flying boat *Clare* (G-AFCZ) made a flight from a base in England to Newfoundland, continuing on to Montreal and New York. The flying boat was inspected before the start by Sir Archibald Sinclair, Secretary of State for Air. It was commanded by Capt. Kelly Rogers, and the crew included Capt. E. Rotherham (second pilot), Mr. C. E. Wilcockson (first radio officer), Mr. J. L. Burgess (second radio officer), and Capt. E. R. B. White, whose great responsibility was navigation without the usual aids available in peacetime. The flight from Eire to Newfoundland took 16 hours 6 minutes. It is the first of a series, in which the authorities of Eire, Newfoundland and Canada are co-operating with navigational facilities.



4,000 H.P. The Consolidated type 31 is powered by two of the new Wright two-row Duplex-Cyclone engines, and is probably the world's most powerful twin-engined flying boat. The "retractable tricycle undercarriage" is a beaching trolley. The struts of the outboard floats fold into the wing. The machine has accommodation for 52 passengers in the daytime and 28 at night.

Model Restrictions

THE Society of Model Aeronautical Engineers announce that by an Order of the Air Council a ban has been placed on the flying of certain types of model aeroplanes. Under the new restrictions no petrol-driven models may be flown, nor any gliders or elastic-driven models having a wing span in excess of 7 ft. There are no restrictions on models of any other type.

Douglas Commercial Orders

THE Douglas factory had a personnel exceeding 17,000 in June, and the "backlog" of orders is $117,000,000. Though most of this is for military craft, $23,000,000 is for commercial types, with the big DC4 heading the list with 46 on order. T.W.A. has a big order for DC3s of a later version, said to have a longer passenger cabin and to seat 24. The airline will take 15 of these at a reported cost of $1,500,000 (approximately £25,000 each).

Eleven of the nosewheel DC5s are on order, one having just been delivered to W. E. Boeing for his personal use. Design work on the DC6 has been started and this is believed to be an improved DC3.

Flying Bombers Across

AS recorded elsewhere in this issue, arrangements are being made for flying across from Canada or Newfoundland such American military types as are capable of covering the required distance non-stop. Capts. Bennett and Page of the Airways Corporation are now in California to discuss the matter with west coast constructors.

More Gifts

THE Gold Coast Spitfire Fund has sent a further £5,000. Since the fund was inaugurated in June, a total of £25,000 has been contributed. The Governor of Trinidad has announced that a further £10,000 has been subscribed, bringing the total to £52,000. The money is "for the purchase of aeroplanes of whatever type His Majesty's Government decide would be most useful." Capt. Leslie Gamage has contributed £5,000, Fiji £52,000, the Bahamas War Committee £10,000, and a further £1,250 has been received from the Cyprus Fighter 'Plane Fund.

A fund organised by the Madras *Mail* has produced £22,500 for the purchase of Spitfires, and the fund opened by the *Palestine Post* has reached a total of £10,000. Two Americans have made a present of a Spitfire each, Mr. Frank Allen and Mr. Frederick Pearson. The latter has requested that the Spitfire presented by him should be named R. J. Mitchell, after the late chief designer of the machine.

Sabotage in America

IT was disclosed by Mr. J. Edgar Hoover, Chief of the U.S. Federal Bureau of Investigation, that acts of sabotage had been discovered. Emery dust in aero engines was said to be one form which the acts of sabotage had taken. It is a little difficult to understand how the presence of the dust escaped the inspectors. Or perhaps it didn't. After all, the report does not state that the engines were run before it was discovered.

FERRY-PILOTING ACROSS THE ATLANTIC. As recorded on p.104 the Airways Corporation is assisting in the work of organising trans-atlantic deliveries. On the left is Capt. A. S. Wilcockson, and on the right Capt. D. C. Bennett.

RADIO DIRECTION FINDING

An Aid to Aerial Navigation

By H. F. JONES (W/T. D/F Lecturer)

THERE is no doubt that position finding by radio is regarded as an essential feature of aerial navigation. Moreover, the development of radio science has played a major part in the development of aerial transport. Proof in abundance being available (in those halcyon days before the pest of Europe graduated as a Vandal) on almost any winter morning at Croydon or Heston Airports, when aircraft were guided to the aerodrome in "QBI" with almost phenomenal accuracy.

It is no idle boast to state that without the aid of radio bearings at least 95 per cent. of winter transport services would have been utterly impossible.

In spite of the obvious importance of radio bearings, it is perhaps surprising to find a lack of suitable literature dealing with the various problems involved, in non-technical language, for the information and guidance of aerial navigators.

Radio direction finding is made possible by the characteristic properties of a loop aerial, designed to be rotatable about its vertical axis.

The loop is connected to a receiver, the function of which is to convert electrical impulses into sound waves by the action of the telephone diaphragm.

We are not concerned with the action of the receiver and its associated circuits, but we are very much concerned with those sound waves, to which we refer as the signal strength.

The energy picked up by the aerial is fed to the receiver and subsequently reproduced as a signal whose strength is determined by several factors.

Fundamentals of D/F

One of the important factors is the characteristic possessed by the loop aerial of governing the signal strength according to its position. Furthermore, if the loop is rotated one complete revolution, there will be two positions, each 180 degrees apart, of maximum signal strength, and two positions likewise 180 degrees from each other of minimum signal strength. If a pointer is attached to the spindle of the loop axis, the loop may be swung to a position of minimum signal strength, and the pointer adjusted to be in line with the receiving station and the transmitter station. The pointer will be correct for any other station, and the loop will be in a position at right angles with a line drawn from the transmitter to the receiver. If the loop is rotated 90 degrees from this position, it will lie parallel with the line of transmission, and the signal strength will be maximum. A brief reference to the sketch opposite will illustrate the example:—

It is, therefore, apparent that a rotatable loop provides a means of determining a position line. This is clear from a consideration of the two minimum positions, each 180 degrees apart. One of these bearings is obviously the true bearing, and the other the reciprocal. This is known as the ambiguity of the system, but is by no means an insurmountable difficulty. If a true bearing is required, it may be computed by obtaining two radio bearings from two stations in different geographical positions, plotting a position line from each and obtaining a fix, thus getting rid of the ambiguity.

A second method is frequently employed by which the reciprocal bearing is entirely eliminated.

Elimination of Ambiguity

When the true bearing of a station is required, the operation is known as "sense finding," and is accomplished by switching a second aerial into the receiver circuit. The object is to modify the electrical properties of the receiver in such a manner that for one revolution of the loop there will be only one minimum position and one maximum. The circuit is arranged so that the minimum position will point in the direction of the transmitting station aerials.

It would appear that "sense finding" forms an ideal method of obtaining true bearings without the introduction of ambiguity. Unfortunately, this is not the case.

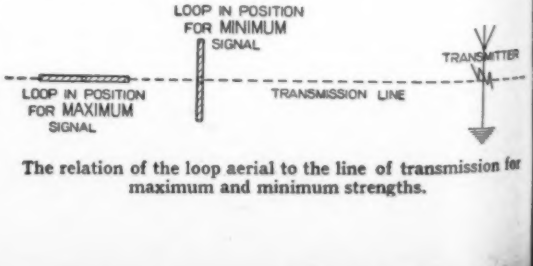
The minimum signal position produced with the "sense finder" is not well defined. It is referred to as "blurred" minimum, or indistinct. The pointer may cover several degrees, over which the minimum signal would be divided. The accuracy of such a bearing is obviously doubtful.

It must be understood, however, that the difference between the maximum and the minimum signal is so well defined that there is no hesitation in selecting the direction of the minimum. Having determined this point, it now remains to switch out "sense" and obtain a true minimum by means of the loop only.

The foregoing may be considered as a brief dissertation covering some of the important characteristics of a rotatable loop aerial.

The application of radio direction finding to aerial navigation introduces serious problems that the navigator cannot afford to ignore. In fact, to disregard these problems would lead to disaster.

It should be appreciated that radio bearings are Great Circle bearings, due to the fact that wireless waves fol-



The relation of the loop aerial to the line of transmission for maximum and minimum strengths.

RADIO DIRECTION FINDING (CONTINUED)

low the earth's surface. It is understood, however, that only a portion of the energy travels in this manner, it being referred to as the ground wave. The remainder of the energy travels in a vertical plane, and is known as the sky wave. These two components travel together.

In the daytime the sky wave does not influence the loop aerial system to any appreciable extent, but at night it is reflected earthwards, due to the action of a layer of electrified gases known as the Heaviside layer. It bends the sky wave downwards, and under these circumstances does influence the loop. The effect of the reflected sky wave is to create indistinct and "blurred" minimum signals. Several minimum signal points are sometimes created for one revolution of the loop. Maximum degree of Night Error is created at sunset and sunrise, when it is understood the Heaviside layer becomes particularly turbulent. Therefore, radio bearings obtained with a loop aerial system at night should be regarded with suspicion.

Night Error has been largely eliminated on ground stations by removing the upper horizontal wires of the aerial system and feeding the lower horizontal wires in a screened tube underground to the receiver. The system is known as the Marconi-Adcock system.

Coastal Refraction

This is an error that may occur within a radius of approximately ten miles from any coast line. There is a very slight difference in the velocity of wireless waves over water and over land, and this may be the reason explaining why the waves have a tendency to bend when crossing the boundary and arrive at the receiver from an erroneous direction.

There is no means for correcting for coastal error. Charts may be marked with an arc, indicating that bearings obtained within that arc are unreliable.

Providing, however, that the aircraft is more than ten miles from the coast, and the ground station likewise, the coastal error may be ignored.

Quadrantal Error

The magnitude of this error may be as much as 12 degrees, according to the construction of the aircraft, and will vary with individual machines. It is maximum at the quadrantal points of the aircraft. Taking the aircraft's head as "0," there will be a maximum error at 45 degrees, 135, 225 and 315 degrees. The errors can be computed by swinging the aircraft on a known station and plotting a correction curve, which will hold good for any other station. Bearings obtained by the aircraft's loop must, therefore, be corrected for quadrantal error before being applied.

In large all-metal aircraft, especially of the boat class, there is usually an inclination for the minimum signal to be "blurred" when obtaining a bearing from a station that is broadside on to the aircraft, either 90 or 270 degrees.

It should be appreciated that the nearer the aircraft is to the ground station the more accurate will be the bearing.

In conclusion, may I extend my sincere appreciation and express admiration for the efficient operation of the pre-war Air Ministry Signals Staff at Croydon Airport, who, with commendable patience, made possible the smooth running of air transport and guided many thousands of airliners to a safe and happy landing.

FULL-SCALE PROJECTION

An Ingenious Labour-saving Camera

A CAMERA of truly heroic proportions is being used by the Glenn L. Martin Company of Baltimore to photograph engineering drawings and project them, full scale if necessary, on to the emulsion-coated surface of aluminium alloy, wood, paper or cloth. As the maximum size of sheet used is 10 by 5 feet, the great size of the camera will be realised. The great advantage of the process lies in the fact that the shape of a part can be projected photographically on to the metal out of which it is going to be cut, so saving the time of laboriously transferring the detailed dimensions. And if several parts have to be cut, the process can be repeated at great speed.

Another application is in the making of models. If a wind-tunnel or tank model of a projected aeroplane is desired, it is only necessary to call on the camera to scale down the lines instantly from full size to an eighth or tenth or any other fraction. An easy calibration of the camera is all that is required, saving much redrawing to scale.

Moreover, the huge camera is called upon for many other duties. Besides projecting drawings, it photographs typewritten pages, with pictures in ink, pencil or half-tone photographs, on to metal plates and these are specially treated to become lithographic plates for rapid reproduction by the multilith method. It can also retake ordinary photographs, "blowing them up" on paper or canvas or wood panelling to sizes as large as 10 by 5 feet.

But the greatest saving to the Glenn L. Martin Company has been as an engineering adjunct. Although the Baltimore factory has more than 900 design personnel on its payroll of about 12,000 people and is searching for hundreds more, its "mechanical draftsman" has been very valuable.

It is in the lofting work that the Martin photographic reproduction process steps into its busiest job. Between the sweeping contours drawn on the loft floor, the details of the many sections of the aeroplane are drawn in on the loft layouts, which are large sheets of aluminium alloy coated white on one side. No ink, only pencils, are used for this work. Few dimensional figures are necessary because the sections are in full scale. And when a loft layout is finished as a drawing, it goes along a hall to the big camera and as many copies as necessary are struck on white-coated metal sheets that become duplicates, and the original goes into a file for permanent record. (The metal, of course, has the advantage that it is not subject to change of size when humidity alters.)

Tool design gets at least one duplicate from which steel templates or other tools are made. The production department may also get one or several of the loft layouts to keep constant check on the arrangement of fixtures and the assembly of the parts. Others may go to various members of the engineering staff.

The many errors of the old style of redrafting each loft layout several times is eliminated by the new process. Once an original drawing is checked carefully, no further error can be made because each reproduction is exact.

The system is of inestimable value also in the making of "mock-ups." Since a full-scale model of every new aeroplane type must be built first of wood to give engineers, tool designers, and production planners their final information, the ability of the "mechanical draftsman" to photograph drawings directly on to the surface of both painted and unpainted wood saves time and effort. Skilled craftsmen in the woodworking shop are thus enabled to work directly on many of the mock-up parts without constant reference to drawings.

Still another interesting function of the new process is in the making of "shrink layouts." Because zinc and other metals moulded into dies shrink considerably by cooling, it has always been necessary either to make new drawings to allow for this shrinkage or to use a shrink-scale. But, because the shrinkage is a known factor, it is customary by a simple calibration of the camera to let the lens do in a moment what might consume many hours of time of trained technical men if done by older methods.

SERVICE AVIATION

Empire Air Training : Parade at the R.C.A.F. Station at Ontario.

Royal Air Force Official Announcements

Duke of Kent at R.A.F. Station

OFFICERS and airmen of General de Gaulle's army of Free Frenchmen who have taken part in recent raids with the R.A.F. were introduced to the Duke of Kent when he visited an R.A.F. station in East Anglia. The Duke of Kent, who holds the rank of Group Captain, was accompanied by Air Vice-Marshal J. E. A. Baldwin, made a complete tour of the station in his capacity as welfare officer.

Grenada's Contribution

LORD LLOYD, Secretary for the Colonies, has sent the following telegram to the Governor of the Windward Islands:—"I have learned with admiration and appreciation of the generous gift of £6,200 from the people of Grenada to the Grenada War Purposes Committee. As requested, £5,000 is being paid to the Ministry of Aircraft Production for the purchase of a fighter plane and the balance to the four charities named."

R.A.F. Canadian Mail

CORRESPONDENCE and parcels addressed to personnel of the Royal Air Force who are at present training in Canada should be addressed as follows:—Air Force Number. Rank. Name. Unit (including the letters "R.A.F."), c/o The Royal Canadian Air Force Headquarters, Ottawa, Ontario, Canada. The sender's name and address should always be shown clearly on the outside of the packet, preferably on the back in the case of letters. In no case, however, should these particulars obscure or prevent the easy and quick reading of the name and address of the addressee.

Training Appointments

THREE new Directors have been appointed under Air Vice-Marshal Garrod, the recently appointed Air Member for Training. Air Comdre. A. J. Capel, D.S.O., D.F.C., will be Director of Operational Training; Air Comdre. A. H. Orlebar, A.F.C., will be Director of Flying Training, and Group Capt. M. Thomas, D.F.C., A.F.C., has been given the Directorate of Technical Training.

All three officers come to the Air Ministry with experience in operational command, and all three have served in the infantry in the last war. Air Comdre. Capel was Senior Air Staff Officer of the Royal Air Force component of the British Expeditionary Force, having served with the Royal Air Force and Royal Flying Corps since 1915. He commanded a squadron in India between 1923 and 1928, and received the D.F.C. for gallantry during operations in Waziristan.

Air Comdre. Orlebar was seconded from the Infantry to the Royal Flying Corps in May, 1916, and served as a pilot both in France and at home. He is best known from his association with the R.A.F. High-Speed Flight, which he commanded in the years 1929 and 1931, when the teams under his training won the Schneider Trophy contest outright for Britain. He at one time held the world's speed record on a Supermarine S.6 at 357.7 m.p.h. Recently he has been on the staff at Fighter Command.

Group Capt. Thomas served as a rifleman in the 16th London Regiment in 1914, receiving a commission in 1916. He became a Flying Officer in the R.F.C. in 1917, and was granted a permanent commission in the R.A.F. in 1919. In addition to staff and flying duties at home, he has also served in Mesopotamia and India. He received the D.F.C. for distinguished services during active service operations in Iraq in 1922 and the A.F.C. for distinguished services during the 1914-18 war.

"Flight" photograph.

Air Commodore A. H. Orlebar, A.F.C., appointed Director of Flying Training.

Belgian Air Force

AFTER reorganisation, Belgian Forces are now again taking an active part in the war. Air squadrons are fighting in co-operation with the R.A.F., and new units will be recruited from Belgian volunteers who have come from the Continent to continue the fight. Since most of the Belgian equipment was of British manufacture—they had, for instance, Hawker Hurricanes, Gloster Gladiators, and Fairey Battles—no difficulty should be experienced in falling in with the new régime.

R.A.F. Sergeants Decorated

ON Monday of last week, at a Bomber Command station in the Midlands, fifteen sergeants were decorated with the D.F.M. by Air Marshal Sir Charles Portal, Air Officer Commanding-in-Chief, Bomber Command. They included a pilot, four observers and ten air gunners, and some were not yet completely recovered from wounds received in action. Sgt. Gamble attended the parade in an invalid chair. He was a gunner in a machine which was attacked by a formation of He. 113s. Despite the fact that he was wounded in both legs, he continued firing with great skill and until intercommunication was broken, described accurately to his pilot the tactics of the enemy fighters.

The pilot decorated was Sgt. H. S. Gunning, and he received his medal for an achievement while on reconnaissance over the Heligoland Bight. As he came through the clouds he observed an enemy submarine on the surface. Diving to the attack he dropped four bombs between the stern and the conning tower.

Prisoners of War

FOLLOWING is the latest list of British prisoners of war in enemy hands, as broadcast by German radio:

Sgt. H. G. Cumpsey (wounded), Kilcreggan, Scotland; Sgt. Murray (shot down near St. Omer, June 30), Bromley, Kent; Sgt. D. C. Dunn (wounded), address not given; Sgt. Hawkins (shot down near St. Omer, June 30), Muswell Hill, London, N.12; Sgt. Roach (shot down near Norfoux, June 30), Newport; Sub. Lt. Cadell (shot down near Alsmere, July 2), address unknown; Sgt. Caldwell (shot down near Kiel), Cheetham, Manchester, 8; G. Coyne, Gravesend, Kent; A. Land, Leeds; A. Bell, Thornaby-on-Tees; D. Campbell, Aberdeen; D. Holliday, Pickering, Yorks; R. McLaughlin, Perthshire, Scotland; A. Edwards, Wolverhampton; L. B. Lyons, Brighton; A. Brill, Bradford, Yorks; H. J. Notley, Leek, Staffs.

SERVICE AVIATION (CONTINUED)

Awards

THE KING has been graciously pleased to approve the following appointment and awards:—

APPOINTED A COMPANION OF THE DISTINGUISHED SERVICE ORDER.

Wing Cdr. the Earl of Bandon.

AWARDED THE DISTINGUISHED FLYING CROSS.

Wing Cdr. J. H. Edwardes-Jones, Wing Cdr. J. W. Gillan, A.F.C., Sqn. Ldr. J. W. C. More, Sqn. Ldr. J. S. O'Brien, Sqn. Ldr. C. W. Pearce, R.A.A.F., Sqn. Ldr. F. G. L. Smith, Sqn. Ldr. E. W. Whitley, Act. Sqn. Ldr. M. Hallam, Act. Sqn. Ldr. N. P. Samuels, Act. Sqn. Ldr. D. L. England, Flt. Lt. J. A. O'Neill, Act. Flt. Lt. L. V. E. Atkinson, Act. Flt. Lt. J. Avent, Act. Flt. Lt. M. H. Brown, Act. Flt. Lt. H. Bulden, Act. Flt. Lt. A. R. Oakeshott, Act. Flt. Lt. B. J. E. Lane, Act. Flt. Lt. J. F. Newman, Act. Flt. Lt. P. C. Pickard, Act. Flt. Lt. A. F. Riddlesworth, Act. Flt. Lt. J. R. S. Romanes, Act. Flt. Lt. J. E. Scoular, Act. Flt. Lt. P. H. A. Simmons, Act. Flt. Lt. J. R. T. Smalley, Act. Flt. Lt. R. Thomas, Act. Flt. Lt. M. L. Wells, F/O. P. D. S. Bennett, F/O. T. P. A. Bradley, F/O. J. K. Buchanan, F/O. M. T. G. Henry, F/O. G. A. Lane, F/O. S. L. Ring, F/O. G. S. P. Rooney, F/O. A. L. Taylor, F/O. S. G. Wise, P/O. R. O. Altmann, P/O. T. C. Murray, P/O. H. F. O'Neill, P/O. E. I. Parsons, P/O. T. L. S. Smythe, P/O. N. H. Svendsen, P/O. K. D'A. Tauté, P/O. K. W. Trigance.

AWARDED A BAR TO THE DISTINGUISHED FLYING MEDAL.

Sgt. A. S. Johnson, D.F.M.

AWARDED THE DISTINGUISHED FLYING MEDAL.

Flt. Sgt. A. A. Emery, Sgt. C. R. Alexander, Sgt. H. J. W. Bareham, Sgt. G. B. Blacklock, Sgt. P. W. Campbell, Sgt. J. W. Carter, Sgt. M. C. Cleary, Sgt. C. E. Coote, Sgt. J. Corney, Sgt. W. Ellis, Sgt. W. Foster, Sgt. J. E. Gibbs, Sgt. P. L. Hennigan, Sgt. F. R. Hibbert, Sgt. W. S. Hillary, Sgt. R. F. H. Jones, Sgt. W. R. Keirnan, Sgt. R. Lambert, Sgt. J. G. Maccoubrey, Sgt. R. W. P. McFarland, Sgt. W. I. Mackay, Sgt. E. C. Parker, Sgt. H. I. Popay, Sgt. R. A. Reece, Sgt. B. J. Rowe, Sgt. A. J. Scott, Sgt. C. L. Smith, Sgt. S. J. B. Snowden, Sgt. W. J. Stephens, Sgt. R. R. Stowe, Sgt. J. Sutcliffe, Sgt. A. E. Taylor, Sgt. V. F. E. Treherne, Sgt. J. V. West, Sgt. J. M. Wilde, Sgt. E. P. Williams, R.N.Z.A.F., Sgt. J. De L. Wooldridge.

The above awards are for gallantry and devotion to duty in the execution of air operations.

London Gazette

ROYAL AIR FORCE.

General Duties Branch.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation:—Flt. Sgt.: (June 18, Sen. May 2) R. Middleton. Sgts.: (May 15) R. C. Wilkinson; (June 21, Sen. May 9) R. F. Jones; (June 28, Sen. May 2) J. R. Graham; (June 29, Sen. April 25) A. Reece; (July 2, Sen. June 12) G. F. Reid; (July 4, Sen. May 2) F. D. Flinn; (July 8, Sen. April 25) J. E. Proctor; (July 10, Sen. May 30) M. F. Patrick; (July 11, Sen. May 2) S. D. J. Dalgleish; (July 15, Sen. May 9) J. G. B. Hartley.

2nd Lt. E. K. Barnes, R.A. (T.A.), is granted a temporary commission as Pilot Officer on being employed with the Royal Air Force (July 6).

Act. Pilot Officer on probation K. T. Knights is graded as Pilot Officer on probation (October 11, 1938).

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant:—(April 26) P. Hadfield; (May 28) L. E. Abel; (June 6) D. E. C. Trench, G. T. Openshaw; (June 18) R. H. Warcup; (June 19) H. F. Burton, L. F. Cooper, R. M. B. D. Duke-Woolley; (June 25) A. Beck, W. N. Sykes, P. M. J. Evans; (June 28) C. S. H. Richardson; (June 29) D. E. A. Williams; (July 6) J. W. C. Simpson, D.F.C.; (July 16) N. C. Harding.

The undermentioned Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—(April 20) F. M. Boycott; (May ?) T. R. Turnbull; (May 23) J. R. Grant; (May 25) S. P. Stephenson; (May 29) J. G. Fleming; (May 30) J. M. Hogston; (June 1) L. H. Carey; (June 6) H. F. Marcou; (June 17) J. R. Armitstead, H. J. Cundall, I. S. Henderson, K. P. MacKenzie, L. MacD. Hodges; (June 23) W. A. Griffiths; (June 29) N. A. Sellars; (July 12) J. Hamlyn; (July 17) P. B. Alexander.

Air Comdre. A. D. Cunningham, C.B.E. (R.A.F., ret.), is granted the acting rank of Air Vice-Marshal (April 20). (Substituted for notification in the Gazette of April 30.)

F/O. D. R. Miller relinquishes the acting rank of Flight Lieutenant (July 2).

The undermentioned are transferred to the Technical Branch (April 24):—Group Captains: J. R. Cassidy, K. M. St. C. G. Leask, M.C. Wing Commanders: C. C. Bazell, J. A. Elliott, R. Reay-Jones, C. Rapley. Sqn. Ldrs.: W. W. Hart, M.B.E., H. G. Leonard-Williams, P. E. Gwyer, M.B.E. (Ret.), J. Turner, P. F. G. Bradley. Flt. Lts.: R. W. Hase, R. J. Kemsley, D. Saward.

Sqn. Ldr. F. H. Shales is placed on the retired list on account of ill-health (July 22).

P/O. P. S. Goulder relinquishes his short service commission on account of ill-health (July 25).

Errata.

In the Gazette of June 11. Notification concerning 249289 W.O. R. F. Arnold (43588). *For* May 22, 1940, *read* May 1,

In the Gazette of June 25. Notification concerning 344591 W.O. C. W. Holbourn (43720). *For* May 12 *read* May 14.

In the Gazette of July 9. Notification concerning Flt. Sgt. G. Ryder should have appeared under the heading "R.A.F." instead of "R.A.F.V.R."

Technical Branch.

The undermentioned Warrant Officers are granted commissions for the duration of hostilities as Flying Officers on probation: (May 17, Sen. February 15) R. C. Plumtree; (June 9, Sen. May 9) H. J. Hemmings; (June 11, Sen. May 9) W. Proctor; (June 18, Sen. March 14) A. J. Chapman; (June 24, Sen. May 9) C. C. Hicks; (June 25, Sen. May 9) L. W. Tee; (July 1, Sen. May 9) H. W. Gill, A.F.M.; July 6, Sen. May 9) B. R. Grant; (July 6, Sen. July 3) H. F. Cook; (July 11, Sen. July 4) R. H. Rodber; July 12, Sen. March 14) A. R., James; (July 15, Sen. March 14) S. R. Newton.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation: Act. W.O: (July 1, Sen. May 16) R. W. Sutton. Flt. Sergeants: (June 20, Sen. May 16) R. B. Bryan; (July 1, Sen. May 16) W. A. H. Hall; (July 7, Sen. May 16) W. R. Cumbers; (July 9, Sen. May 16) W. G. Evans; (July 9, Sen. May 30) G. A. Glossop; (July 10, Sen. May 16) D. K. Smithson; (July 15, Sen. May 16) A. E. Dunlop. Sgts.: (June 20, Sen. May 30) F. E. Ludgate; (July 16, Sen. July 3) J. Reed.

The undermentioned Flying Officers on probation are confirmed in their appointments: (June 12) A. H. Perry, A. S. Robbins, A. H. King, F. H. Ward; (June 19) S. C. W. Rudd, J. E. Brown, A.F.M.; (June 23) C. D. Connerton, E. F. Price, W. H. Jones; (July 12) J. C. Downie, G. T. E. Rowed; (July 27) G. Costick, H. M. Aspen.

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant (Sen. May 18): (June 3) F. F. S. Mattingley, A. Clifton; (July 29) H. L. Millyard, E. R. Paley, W. J. S. Barnard, M.B.E., L. G. Hucker, B. A. Vautier, R. D. Gough, L. Davey, J. Lindsay, H. J. Maxted, J. A. C. Pride, D. McLaren.

Balloon Branch.

W.O. R. G. C. Browning is granted a commission for the duration of hostilities as Flying Officer on probation (June 17, Sen. April 25).

Administrative and Special Duties Branch.

The undermentioned are granted commissions for the duration of hostilities as Flying Officers on probation (July 8): W.O.: (Sen. May 30) G. J. Buxton; (Sen. June 20) A. F. Wearn.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation: Flt. Sgts.: (June 11, Sen. April 25) A. Readman; (July 8, Sen. June 20), A. W. Jones; (June 24, Sen. June 20) E. Maidment.

Equipment Branch.

W.O. W. T. Stacey is granted a commission for the duration of hostilities as Flying Officer on probation (May 18, Sen. February 29).

Sgt. R. S. George is granted a commission for the duration of hostilities as Pilot Officer on probation (June 19, Sen. May 2).

The undermentioned Pilot Officers on probation are confirmed in their appointments: (May 1) E. C. Carson, P. O. Hudson, J. Trotman.

Accountant Branch.

The undermentioned Warrant Officers are granted commissions for the duration of hostilities as Flying Officers on probation: (July 7, Sen. June 6) A. H. Bruce; (July 17) A. A. T. Parker.

The undermentioned Flight Sergeants are granted commissions for the duration of hostilities as Pilot Officers on probation: (July 5, Sen. June 6) W. Craig; (July 12, Sen. July 8) F. W. W. Hollingham; (July 15, Sen. July 8) R. A. Marshall.

P/O. on probation J. R. Cox is confirmed in his appointment April 17 and promoted to the rank of Flying Officer June 1.

P/O. on probation D. G. Leader-Williams is confirmed in his appointment and promoted to the rank of Flying Officer June 10.

Medical Branch.

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant (June 5, Sen. June 5, 1939) H. M. Carson, M.B., B.Ch.; (Sen. March 5) C. W. S. Marris, M.R.C.S., L.R.C.P.

Dental Branch.

Flt. Lt. H. D. Humphreys, L.D.S., is granted a permanent commission and is promoted to the rank of Squadron Leader (July 1).

Royal Air Force Reserve

RESERVE OF AIR FORCE OFFICERS.

General Duties Branch.

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant: (September 3, 1939) R. I. Johnson; (March 8) R. Benham; June 28, I. N. Roome.

The undermentioned Pilot Officers are promoted to the rank of Flying Officer (June 13): A. F. A. Underhill, F. W. P. Barretto, J. E. Jurdon.

Flt. Lt. T. H. Wilson is transferred to the Administrative and Special Duties Branch (May 13).

F/O. G. K. Murray resigns his commission (May 18).

Flt. Lt. J. R. Stewart relinquishes his commission in class CC on appointment to a commission in the R.A.F.V.R. (July 19).

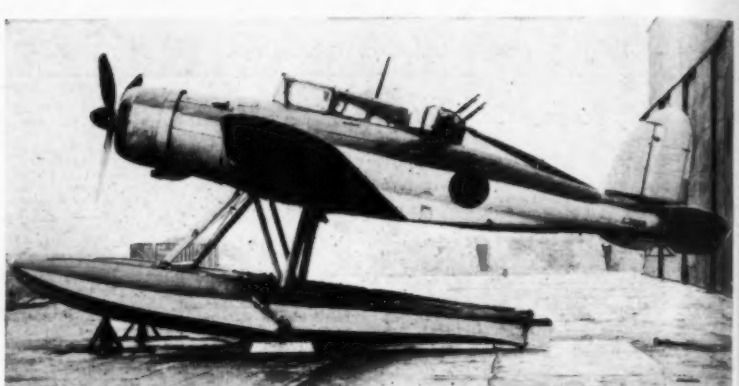
Royal Air Force Volunteer Reserve

General Duties Branch.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation: (June 29) C. C. O. Joubert; (July 5) V. W. Olson; (July 6) A. R. H.. Barton; (July 7) A. G. Donahue. Sgts.: (May 15) E. G. Ford, A. H. B. Friendship, D.F.M.; (June 2) G. Hall, P. G. Thornton-Brown; (June 9, Sen. May 12) M. G. Butt; (June 18) G. A. Langley, E. S. Lock, W. W. McConnell; (June 19, Sen. May 2) R. H. Penny; (June 29) J. J. Gubbins, R. McK. Mansell, R. F. Spencer-Schrader, W. H. H. Holland, A. F. Jefferys, H. C. Pexton, J. B. Linton, R. H. Rose, N. F. Waters-Webb, A. W. Barwood, K. D. Brant, K. B. L. Debenham, J. V. F. Gibbs, W. K. Manifould, W. A. W. Burman, A. A. Salter; (June 30) N. G. R. Booth, J. W. M. Delafons, D. B. Bennett;

PLENTY TO LEARN: Trainees at the R.A.F. School of Photography practise making up line overlaps and map mosaics (our chief photographer says apparently with eight identical pictures).

SERVICE AVIATION (CONTINUED)



A FLEET FIGHTER: The seaplane version of the Blackburn Roc. Amidships is clearly seen the Boulton Paul power-operated four-gun turret.

(July 6) H. K. Atkinson, A. G. H. Cooper, R. McCarthy, S. E. Taitt, G. K. Whiffen, F. R. Wood, J. H. Fisher, E. G. Outram, P. H. George; (July 9, Sen. May 2) P. M. Bristow; (July 15, Sen. April 25) R. C. Dafforn, G. E. Goode; (July 13, Sen. July 11) S. P. Daniels, J. T. R. Chamberlain, K. Cooney, J. O. Fenton, G. L. Campbell, A. F. Y. Lees. Leading Aircraftmen: (June 29) J. Lonsdale; (June 30) G. C. Brown, D. Balmforth, J. T. Houghton, H. M. Christopher, A. Hipps, G. A. Holder, J. O. D. Kellow, H. L. Magee, P. F. Mason, H. E. Pearce, F. J. Sercombe, A. L. Spence.

H. A. De Freitas is granted a commission for the duration of hostilities as Act. Pilot Officer on probation (July 1).

The undermentioned Pilot Officers on probation are confirmed in their appointments (March 29): R. A. Winter, G. M. Merrifield, A. R. A. Forbes, J. E. Jackson, S. W. R. Howell, N. S. Lacey.

The undermentioned are transferred to the Administrative and Special Duties Branch (July 1): P/O. I. C. Strutt, P/O. on probation T. D. Cole.

The commission of Act. P/O. on probation W. St. C. Smith is terminated on cessation of duty (July 11).

Technical Branch.

The undermentioned Sergeants are granted commissions for the duration of hostilities as Pilot Officers on probation:—(July 5, Sen. May 30) F. A. Horley; (July 9, Sen. July 4) L. A. Ballingall.

The undermentioned are granted commissions for the duration of hostilities as Act. Pilot Officers on probation. (Sen. May 30):—Cpl.: (July 4) H. Tonge. L.A./C.: (July 2) J. C. Aldred; (July 3) G. M. McMinn.

Balloon Branch.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation:—A.Sgt.: (July 3, Sen. June 25) A. D. Bide. Cpls.: (July 3, Sen. June 24) A. M. Goldsworth; (July 3, Sen. June 25) W. G. Bennett, G. T. Benton, G. B. Earle, W. Findlay, R. G. Greaves, A. C. Howatson; (July 8, Sen. June 24) A. A. Salmon; (July 9, Sen. June 24) D. M. C. Best, G. C. T. Rickards; (July 10, Sen. June 24) J. D. Buck, H. D. Buckle; (July 15, Sen. June 27) J. C. Turner. L.A./C.: (July 3, Sen. June 25) H. C. Liddell; (July 9, Sen. June 24) R. H. Havart. A/C.1: (June 29, Sen. June 24) A. P. Bailey; (July 1, Sen. June 24) T. E. Lalonde; (July 9, Sen. June 24) J. Eve; (July 10, Sen. February 15) I. W. N. Speight; (July 12, Sen. June 24) J. C. Johnston. A/C.2: (July 3, Sen. June 25) F. P. Badcock; (July 13, Sen. June 27) D. Sperrings, K. H. Young.

Administrative and Special Duties Branch.

Col. J. B. Stewart (T.A.R.O.) is granted a commission as Flt. Lt. (July 19, Sen. May 24, 1937.)

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation:—(June 10) F. E. Hodgson; (June 12) D. W. Pugh; (June 21) K. G. Bishop; (June 27) G. Wallas; (July 2) T. N. Barling, T. M. Dowell, J. F. Mead, C. V. Richardson, P. L. D. Teichman Derville; (July 3) R. S. Kenyon, E. G. Waldy; (July 4) J. A. Quaife; (July 5) P. R. Allison, L. V. Armstrong, R. H. W. Aylwin, F. J. Bado, T. J. M. Barrington, T. E. Blackall, W. M. Boswell, A. Bourne, H. Brabrook, P. A. B. Branwell, G. Bridge, J. N. Britton, W. C. Brown, J. Bunton, W. J. Cornish, K. H. Donovan, I. C. Duthie, F. Haile, C. Hailey, E. S. Harman, M. Hermiston, P. N. Jarboe, K. E. H. Kay, H. M. Langley, V. A. Lanos, R. W. Leaning, C. N. Lees, J. L. Lutwyche, P. de L. Markham, N. D. Marshall, J. S. C. Maughan, R. C. Mildner, L. B. Ocamb, A. Parlato, K. F. Powell, D. W. Robinson, O. G. Simpson, R. E. Skelley, J. Skinner, S. W. G. Sloan, R. J. Sullivan, E. H. Swain, H. J. P. Whitcomb, M. T. Woodcock, F. E. Young; (July 6) D. W. Dobson, T. F. Raine; (July 7) J. R. Cobb, E. B. Johnson; (July 8) V. A. Albrecht, R. F. V. Britnell, H. H. M. Carpenter, E. H. Cuthbert, B. S. Foster, S. F. O'G. Haslam, G. W. Latimer, J. H. Lundy, F. S. Scott, E. W. Stonehouse; (July 9) P. G. Ashwin, E. A. Dearman, A. R. L. Knight, W. G. Morris, F. G. Roberts, O.B.E., P. W. Spurr, E. W. Sykes, C. Vaughan; (July 10) E. S. Benson, L. W. Biggs, H. F. W. Brooks, W. N. Davis, B. Elias, N. F. Gossage, A. C. Harper, H. Hoyle, D. M. Johns, R. D. Paul, H. G. Suddards, A. F. Vigor; (July 11) F. O. Levers, E. D. Pitman, G. B. Sambidge; (July 12) H. W. Gammon, C. M. Gold, W. C. Kendrick, C. R. Payne, E. V. Pearce, J. R. Sherborne; (July 15) C. G. Bardswell, G. J. le B. Beaumont, C. H. C. Brown, E. Cawston, E. C. De Rougemont, J. L. Hayward, E. M. Heron, A. N. Hoole, R. Maudling, H. G. Messer, A. I. Orr-Ewing, S. N. Pike, J. A. Plowman, D. L. Rawnsley, L. R. Ray, P. G. Rossel, E. Sankey, J. G. T. J. Strangman, L. W. B. Peeling, A. M. Wallace, J. O. B. Wraith; (July 23) E. N. Marriott, H. S. Smith. W.O.s: (July 9, Sen. July 4) W. F. Allen, E. R. Slee. Flt. Sgt.: (July 9, Sen. June 20) G. E. Farquharson. Sgt.: (May 29, Sen. April 25) G. G. Elliot. A.Cpl.: (June 18, Sen. April 25) A. E. Thomas. L.A./C.: (July 4, Sen. April 25) J. B. Rose. A/C.2: (June 3, Sen. April 25) J. H. D. Young; (July 8, Sen. May 30) B. S. T. Brookes.

A/C.1 R. W. O'Farrell is granted a commission for the duration of hostilities as Act. Pilot Officer on probation. (July 15, Sen. June 17.)

The undermentioned Pilot Officers on probation relinquish their commissions on account of ill-health:—(July 20) J. Tennant; (July 29) E. F. Palmer.

Hon. Flt. Lt. H. G. L. Wilkinson relinquishes his hon. commission on cessation of duty (July 21).

Erratum.

In the Gazette of July 2. For F. A. Smith *read* F. Armitage-Smith.

Equipment Branch.

The undermentioned Acting Pilot Officers on probation are graded as Pilot Officers on probation:—(July 15) S. J. T. Bryer; (May 25) E. W. Piggott.

Pilot Officer on probation E. R. Smooha is transferred to the Administrative and Special Duties Branch (January 10).

Accountant Branch.

The undermentioned are granted commissions for the duration of hostilities as Acting Pilot Officers on probation:—(July 9) C. O. Bartley. Cpls.: (June 29, Sen. June 6) A. R. Wesley; (July 1, Sen. June 6) N. W. Harper.

Medical Branch.

The undermentioned are granted commissions for the duration of hostilities in the ranks stated:—(July 9): Squadron Leader D. W. McLean, M.B., Ch.B., D.O.M.S. Flight Lieutenant: S. Ball, M.B., Ch.B., M.R.C.S., L.R.C.P., D.P.H. Flying Officers: E. J. Blair, M.D., B.S.; J. F. Cooper, M.R.C.S., L.R.C.P., L.M.S.S.A.; T. Fenwick, M.B., B.Chir., M.R.C.S., L.R.C.P.; W. T. Gordon, M.B., Ch.B.; A. Hargreaves, M.B., B.Chir., M.R.C.S., L.R.C.P.; J. D. Jenkins, M.B., B.S., M.R.C.S., L.R.C.P.; T. L. Stoate, M.B., B.Chir., M.R.C.S., L.R.C.P.; W. B. Waterfall, M.B., B.Chir., F.R.C.S.

F/O. P. E. G. Burnett, M.R.C.S., L.R.C.P., is promoted to the rank of Flight Lieutenant (May 9).

Dental Branch.

The undermentioned are granted commissions for the duration of hostilities as Flying Officers:—(July 9) C. R. Fane, L.D.S.; R. C. Lillicrap, L.D.S.; R. R. B. Payne, L.D.S.; B. F. Vellender, L.D.S.

Chaplains Branch.

The undermentioned are granted commissions for the duration of hostilities with the relative rank of Squadron Leader:—(July 6) The Rev. A. J. Kavanagh; (July 16) The Rev. F. W. Bowyer, B.A.; The Rev. R. R. Clements.

Auxiliary Air Force

Equipment Branch.

F/O. I. R. Taylor is transferred to the Balloon Branch (July 15).

Accountant Branch.

P/O. J. Liddell-Simpson is transferred to the Administrative and Special Duties Branch (July 14).

Women's Auxiliary Air Force

The undermentioned are appointed Assistant Section Officers:—(May 16) Sgt. Miss J. Pearman-Smith, Sgt. Miss S. McW. Younger; (July 18) A/CW.2 Miss M. B. Vancourt; (July 20) A/CW.2 Miss D. E. Anderson, A/CW.2 Miss D. Bradford, A/CW.1 Miss M. MacL. Burghes, Sen. Sgt. Miss M. Cardus, Cpl. Miss S. Cookson, Cpl. Miss R. I. Cryer, A/CW.2 Miss K. E. Curnow, A/CW.2 Miss J. H. Donald, A/CW.2 Miss H. S. Fleming, A/CW.2 Miss F. B. Hearth, A/CW.2 Miss C. M. Herbert-Smith, A/CW.2 Mrs. M. H. Hill, A/CW.2 Miss E. M. Hindle, A/CW.2 Mrs. V. D. Hews, A/CW.2 Miss E. J. Huntly, A/CW.1 Miss R. B. im Thurn, Cpl. Miss B. W. M. Lucas, A/CW.2 Miss D. Myer, A/CW.2 Miss B. I. MacP.G. Nicholls, A/CW.1 Miss U. E. Palmer, A/CW.2 Miss E. R. Pattison, A/CW.2 Miss J. M. Payn, A/CW.1 Miss T. A. Pirie, Cpl. Miss I. M. Rerde, A/CW.2 Miss J. Reid, A/CW.2 Miss F. M. Ribdale, A/CW.2 Miss P. J. Shedden, A/CW.1 Miss F. L. Slater, A/CW.1 Miss E. Veevers-Carter, A/CW.2 Miss W. Wetherall, Cpl. Miss M. E. K. Wherry.

TRANSLATION: An aircraftman of the Polish Air Force familiarises himself with the electrical wiring of British types.

SERVICE AVIATION (CONTINUED)

Roll of Honour

AIR MINISTRY CASUALTY COMMUNIQUE No. 41.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed.

KILLED IN ACTION (WHILE FLYING IN OPERATIONS AGAINST THE ENEMY).—A/C.2 P. Aherne, 625621; P/O. J. L. Allen, D.F.C., 70008; P/O. W. Appleby, 42975; P/O. C. A. Bird, 41543; Sgt. J. A. Buck, 742235; Act. Flt. Lt. I. D. G. Donald, 33306; P/O. A. Finnie, 79158; P/O. J. T. T. Fleming, 41277; P/O. G. K. Gout, 41919; P/O. D. A. Hewitt, 76579; Flt. Lt. P. G. Keeble, 37186; P/O. R. P. J. Osborne, 40741; Flt. Lt. C. D. W. Price, 37985; Cpl. W. C. Royle, 518667; Sqn. Ldr. A. T. Smith, 90337; P/O. R. C. Sterling, 77981; L.A/C. K. E. Webber, 537543; L.A/C. M. H. Winship, 540854.

PREVIOUSLY REPORTED "MISSING, BELIEVED KILLED," NOW PRESUMED "KILLED IN ACTION."—Sgt. T. R. Barker, 580937; L.A/C. R. H. Hinder, 551612; L.A/C. C. F. Hudson, 524576; Sgt. H. J. Peacock, 562854; L.A/C. D. M. Rowson, 550760.

PREVIOUSLY REPORTED "MISSING," NOW PRESUMED "KILLED IN ACTION."—Flt. Lt. T. G. W. Appleby, 34227; L.A/C. J. A. Barstow, 550716; Act. Sqn. Ldr. I. V. Hue-Williams, 29210; L.A/C. T. Lowe, 540706; P/O. W. G. McCracken, 36157; Sgt. S. R. Mitchell, 580376; Act. Sgt. A. R. Norris, 580831.

PREVIOUSLY REPORTED "MISSING," NOW REPORTED "KILLED IN ACTION."—P/O. A. M. Dillon, 41991; P/O. J. H. Gordon, 43157; Sgt. J. J. Grierson, 516360; Sgt. G. H. Hudson, 581225; Sgt. L. L. Kerr, 581286; P/O. G. T. M. Mitchell, 90484; Sgt. J. W. Needham, 742691; Sgt. J. W. Paul, 581002; F/O. P. J. H. Rowan, 36133; P/O. A. R. Wales, 41968; L.A/C. C. G. Watts, 569073.

WOUNDED OR INJURED IN ACTION.—Flt. Lt. A. M. Bentley, 33220; Sgt. G. R. Collett, 745500; P/O. V. G. Daw, D.F.C., 41561; F/O. E. C. Deanesly, 90251; Sgt. M. M. Gallewski, 637611; P/O. J. H. Kirton, 41771; Sgt. G. J. Lowe, 580967; Sqn. Ldr. G. A. L. Manton, 32050; F/O. P. A. Nicholas, 39257; Sqn. Ldr. R. G. Taylor, 37578; P/O. R. M. Taylor, 77692.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—P/O. P. A. Leach, 77944; Act. Sgt. R. A. McVeigh, 745740; Sgt. C. Parkinson, 741376; P/O. W. Walker, 76457.

PREVIOUSLY REPORTED "WOUNDED OR INJURED IN ACTION," NOW REPORTED "DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION."—Sgt. T. Jones, 561183.

MISSING, BELIEVED KILLED IN ACTION.—P/O. E. C. J. Cameron, 36237; Cpl. J. Clark, 566218; Sgt. H. Corcoran, 519958; Sgt. J. G. Cowlishaw, 590842; L.A/C. W. Crossland, 522035; Sgt. G. M. Cumming, 743076; P/O. R. A. De Mancha, 80546; Act. Flt. Lt. L. F. Gregory, 37598; P/O. T. A. Grundy, 42306; Sgt. W. A. Hamlyn, 581386; P/O. J. A. Heath-Brown, 42344; Cpl. V. A. Kemp, 550575; P/O. P. C. Lindsey, 41036; Sgt. E. E. Lockton, 840005; Sgt. J. Morton, 642718; Sgt. T. Murray, 540176; Sgt. W. O. H. Style, 521075; P/O. E. J. H. Sylvester, 90556; Sgt. E. Williams, 638749; A/C.1. F. C. Willans, 567878.

MISSING.

MISSING.—Sgt. D. A. Adams, 741918; Sgt. F. P. J. Atkins, 903401; Sgt. A. Avery, 581257; P/O. H. C. M. Bamber, 42375; Sgt. R. C. Beale, 564823; Sgt. B. M. Bennett, 649294; A/C.1. L. C. Bennett, 570382; Sgt. G. E. Bloor, 633207; P/O. J. C. Bowman, 77927; Sgt. M. H. Burton, 580867; Sgt. D. D. Cain, 542,629; Sgt. J. P. Caldwell, 626021; Sgt. J. W. Candlish, 533257; P/O. D. S. Carnegie, 77350; Cpl. D. B. Carter, 534454; Cpl. A. L. Cartwright, 8823; L.A/C. S. Clarke, 518910; Sgt. A. McN. Cockburn, 638760; Cpl. N. Cocking, 542816; Cpl. R. Conkie, 534598; Sgt. E. A. Cotton, 742495; Sgt. W. R. Cowell, 628277; Sgt. J. R. Cowsill, 741936; Sgt. R. Crombie, 903506; Sgt. A. G. Curley, 747968; Flt. Lt. S. E. F. Curry, 37006; Sgt. S. W. Curry, 551339; Sgt. B. N. Dingle, 581277; L.A/C. D. F. Dixon, 610629; Act. Sgt. E. L. Dodd, 746988; A/C.2. E. P. Doolin, 640566; F/O. F. E. R. Ducker, 70191; Sgt. J. K. Easton, 640007; Act. Flt. Lt. D. H. Edwards, 39784; Sgt. H. D. B. Elsdon, 743044; Sgt. A. Evans, 552163; Sgt. G. E. Exton, 640689; Sgt. A. E. Farrow, 511965; L.A/C. D. J. Frame, 535408; Sgt. E. B. H. France, 580739; Sgt. A. J. Giles, 581092; Sgt. M. Gott, 522865; L.A/C. D. Gow, 532923; Sgt. G. J. W. Grimson, 631689; P/O. A. C. Hamilton, 78543; Wing Cdr. J. H. Hargroves, 07128; Sgt. A. J. Harris, 534211; P/O. J. F. J. Haworth, 39734; F/O. P. Hay-Drummond-Hay, 90321; Sgt. C. C. Heyward, 742062; Sgt. C. G. Hill, 550068; Sgt. E. Hill, 633167; P/O. I. M. Hossack, 73568; P/O. R. A. Howley, 41705; Sgt. J. A. Hunter, 628333; P/O. A. K. Jackson, 42840; Sgt. J. B. Jones, 565170; Sgt. D. A. Keetley, 747771; P/O. J. R. Kemp, 41850; P/O. R. Kidson, 41297; Sgt. R. V. Kingshott, 751190; Sgt. S. C. Kirkbride, 566417; Sgt. A. W. Lamont, 523170; Sgt. E. D. Leamy, 569067; P/O. H. F. A. Lees, 78545; Sgt. R. N. Lewis, 636576; Cpl. W. G. Lillie, D.F.M., 538981; P/O. P. Lichfield, 76461; Sgt. R. M. Livermore, 550254; A.C.1. A. Macauley, 6296386; Sgt. W. McCrorie, 615278; P/O. G. E. MacDonald, 42067; Sgt. D. D. Mackinnon, 745928; Sgt. B. J. Mahon, 635470; F/O. J. E. Mahoney, 39237; Sgt. D. Middleton, 551824; Act. Flt. Lt. D. D. Middleton, 39105; Sgt. R. T. Miller, 551536; Sgt. V. C. Monkhouse, 580343; Sqn. Ldr. J. B. S. Moneypenny, 29058; P/O. V. C. R. Morrison, 43204; P/O. G. H. Muirhead, 42532; Sgt. F. Nelson, 516778; Sgt. P. D. Nixon, 580671; Sgt. W. P. O'Heney, 643564; Sgt. E. W. Owens, 550853; P/O. A. D. Panton, 33331; P/O. R. T. Parcezer, 42076; P/O. R. L. Patterson, 77529; F/O. C. D. Pecl, 90199; Act. Flt. Lt. F. Phillips, D.F.C., 37827; Sgt. F. H. E. Phillips, 567099; P/O. F. H. Posener, 41735; Sgt. J. N. Prendergrast, 620735; Sgt. C. E. Read, 580828; A/C.2. L. Redfern, 644120; Sgt. G. Reid, 746818; P/O. R. H. Rigby, 42149; Sgt. C. Rose, 631369; P/O. H. M. Selwyn, 39575; Sgt. D. M. Slatter, 524342; Sgt. E. W. Smith, 366415; Sgt. G. B. Smith, 563351; P/O. J. D. Smith, 42901; L.A/C. W. B. Smith, 566173; A/C.2. E. Sneyd, 935024; Sgt. R. A. Steele, 751178; Sqn. Ldr. J. F. Stephens, 32024; Sgt. L. H. Stride, 546871; Sgt. J. Sulter, 617486; P/O. M. R. Tagg, 42541; A/C.1. G. E. Tanner, 625471; Sgt. J. Tansley, 633130; L.A/C. J. G. Taylor, 529188; F/O. C. R. D. Thomas, 40031; L.A/C. T. J. J. Trickey, 635359; Sgt. R. Y. Tucker, 552711; L.A/C. K. P. Turrell, 531188; Sgt. H. J. F. Tutt, 506095; Sgt. L. A. N. Walker, 755305; Sgt. F. S. Waltho, 633350; Sgt. F. Watson, 580743; P/O. P. G. A. Watson, 74345; Act. Flt. Lt. B. H. Way, 33402; Sgt. J. V. West, D.F.M., 533941; A/C.1. J. A. McL. G. White, 967530; Sgt. I. Winberg, 755939; Sgt. F. J. B. Winch, 640278; Sgt. G. A. Wright, 580504; Sgt. W. Wylie, 541172.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE (WHILE ENGAGED IN NON-OPERATIONAL FLYING DUTIES, OR ON THE GROUND THROUGH ENEMY ACTION).—A/C.2. E. J. Bray, 940071; A/C.1. H. V. Smith, 654382.

KILLED ON ACTIVE SERVICE.—Sgt. E. S. Abery, 904333; P/O. J. B. Ashton, 42552; Sgt. J. A. Beale, 804328; P/O. E. W. Bell, 77775; Sgt. D. Bennett, 742843; P/O. J. L. Bickerdyke, 36266; P/O. A. M. Cooper-Key, 40802; P/O. P. A. Crush, 43097; Sgt. W. Davies, 541173; Cpl. S. E. Floyd, 362380; F/O. C. W. Furse, 70233; P/O. J. R. Hamar, 70898; Flt. Lt. F. N. Hughes, 39084; P/O. A. B. Jones, 42679; Sgt. B. C. Kirkland, 754436; P/O. S. P. Lodge, 77303; Sgt. E. E. H. Osgood, 758217; Sgt. R. A. Osgood, 742599; P/O. R. J. R. Powning, 42321; P/O. R. A. D. Smith, 81045; P/O. P. R. B. Wanklyn, 41760; Sgt. K. O. Webster, 749541; Sgt. D. H. Woodworth, 741304.

PREVIOUSLY REPORTED "MISSING, BELIEVED KILLED," NOW PRESUMED "KILLED ON ACTIVE SERVICE."—L.A/C. K. J. Cyster, 751792; P/O. J. P. Dalton, 41524; L.A/C. G. W. Patterson, 523326; P/O. D. R. Williams, 42172.

PREVIOUSLY REPORTED "MISSING, BELIEVED KILLED," NOW REPORTED "KILLED ON ACTIVE SERVICE."—A/C.2 R. South, 643394.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. F. Alexander, 741120; P/O. D. L. Bisgood, 41656; P/O. D. E. Bond, 41148; P/O. C. M. Burfield, 33508; Sgt. R. B. Capes, 741013; L.A/C. R. P. Channel, 749779; L.A/C. N. A. Cooper, 501853; P/O. S. G. Cooper, 42301; P/O. A. R. Downer, 80820; Sgt. D. D. S. Edgar, 741642; A/C.1 W. C. Gallagher, 626774; A/C.2 A. H. Garratt, 1160701; P/O. R. Gray, 72081; L.A/C. R. H. Jones 665527; Cpl. D. P. J. Lean, 580910; A/C.2 J. H. Meadowcroft, 947860; W/O. H. T. Sharp, 333413; L.A/C. J. L. Walker, 533583.

DIED ON ACTIVE SERVICE.—Cpl. G. W. Barnes, 51787?; A/C.2 R. W. Bennett, 926312; Sgt. J. E. Catchpole, 754642; A/C.2 C. E. Clark, 1163223; A/C.2 N. W. Darby, 1350820; A/C.1 F. S. R. Fletcher, 48924; L.A/C. R. Garner, 751676; A/C.2 A. J. Godwin, 1157569; A/C.2 S. Hague, 953419; Sgt. F. S. King, 514418; A/C.2 G. D. Protheroe, 1163626; A/C.2 L. J. Rushton, 968743; Flt. Sgt. F. G. Wells, 341671.

PREVIOUSLY REPORTED "MISSING," NOW REPORTED "SAFE."—L.A/C. J. A. Watt, 755255.

PREVIOUSLY REPORTED "MISSING, BELIEVED KILLED," NOW REPORTED "PRISONER OF WAR."—L.A/C. R. D. Erskine, 591505; P/O. F. Hugill, 43422.

Prisoners of War

PREVIOUSLY REPORTED "MISSING", NOW REPORTED "PRISONER OF WAR."—Sgt. L. Askham, 621279; Sgt. C. S. G. Beevers, 564349; P/O. B. A. Davidson, 42699; Sgt. W. H. Eden, 580404; Sgt. J. Fisk, 581381; Sgt. R. J. Fisk, 625214; Sgt. E. V. Gawith, 507940; Sgt. A. K. Griffiths, 543756; L.A/C. J. G. Hepburn, 551354; P/O. A. J. Hill, 42004; P/O. L. P. R. Hockey, 76011; Sgt. K. A. R. Macarthur, 747956; Sgt. C. J. Scanlon, 553514; L.A/C. J. G. Thomson, 755699; Sgt. C. Webb, 540410; Sgt. J. Whalley, 562373; P/O. R. A. G. Willis, 41766.

PREVIOUSLY REPORTED "MISSING, BELIEVED KILLED ON ACTIVE SERVICE," NOW REPORTED "MISSING."—Sgt. R. Micklethwaite, 636376; Sgt. D. Murrie, 751305.

Royal Canadian Air Force

OFFICIAL CASUALTY LIST No. A2.

KILLED IN FLYING ACCIDENT.—F/O. W. G. Middlebro, C817; L.A/C. H. B. Brock, 77A; F/O. J. J. A. V. Lalonde, C1012; Cpl. M. J. Armitage, 2402.

DROWNED.—L.A/C. J. I. A. Sauve, 7676.

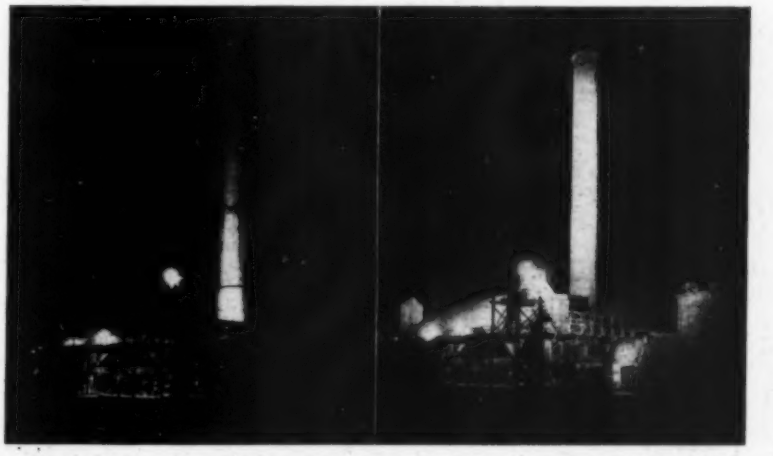
FLOODLIGHTING OF OBSTRUCTIONS

JUST before the outbreak of war several experiments were proceeding on floodlighting tall chimneys. It is interesting to note that the experience that one company, The General Electric Co., Ltd., gained from the tests has proved of value in advising on an installation of this kind overseas.

Floodlighting has been considered as an alternative to the red obstruction lights.

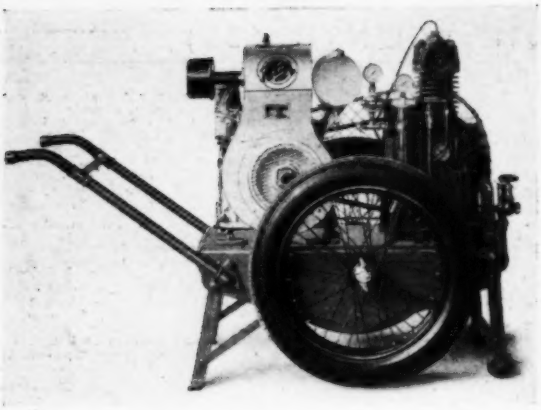
The overseas example mentioned concerns the lighting of five chimneys near the airport of Perth, Western Australia, The British General Electric Co. Pty., Ltd. (the G.E.C.'s branch company in Australia), having been called in by the Commonwealth Works Department

The chimneys are 200ft. high and constructed of red brick. It was desired that the light centre should lie towards the top of the chimney. G.E.C. floodlights of the high efficiency mirror glass parabolic reflector type were selected, these being particularly robust in construction. By utilising 1,000 watt Class B2 Osram projection lamps, a strong narrow beam was provided.



The British General Electric Company improved on the initial attempts at floodlighting this chimney with the result shown.

THE INDUSTRY



The petrol engine powered B.E.N. "Pneu-Matic 12" portable unit.

Air Compressors

AIR compressors of all types are dealt with in a catalogue issued by B.E.N. Patents Limited, of High Wycombe, Bucks. The use of compressed air for various manufacturing processes is being extended every day, and the complete range shown in this catalogue is the outcome of years of specialised experience in designing and producing plant of this description.

Both water- and air-cooled models are listed in single-stage and two-stage units for light work and heavy duty. Petrol or electric units, complete with air receivers, designed for specific purposes such as tyre inflation or spray painting, are described in some detail, as is also the auxiliary equipment required for compressed-air installations.

Equipment, however, has been dealt with rather more fully in a separate publication issued by B.E.N. under the title of Compressed Air Valves, Couplings and Equipment. This includes a fully illustrated list of air line fittings, air valves and accessories of every kind. New products are catalogued for the first time, and several which have given satisfactory service over a long period appear in an improved form. Copies of either or both of these publications may be had direct from B.E.N. Limited.

Newman Motorised Unit

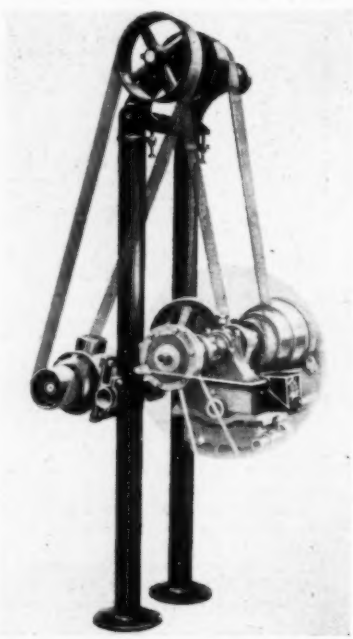
MANY machines and machine-tools are manufactured to-day as self-contained units. That is to say, an electric motor is incorporated and all that is required is to connect up to the electricity supply.

To motorise a machine is to modernise it, and that is what the Newman Unit is for. It is a self-contained motorised unit, designed to drive any cone-pulley machine, and to operate by electric push-button control.

The Newman Unit comprises a frame built of twin steel tubular pillars surmounted by steel bearing brackets which carry the ball bearing countershaft and cone pulley normally supplied. These pillars are secured by a horizontal cross-member, the whole welded together to form an elongated H shape upright frame. Flanged feet are provided to the pillars for anchorage to floor, and a third anchorage point is provided by a bar extending from the horizontal cross-member to a convenient fixing point on the machine. When bolted in position immediately behind the machine's cone pulley, the unit stands absolutely rigid and free from vibration.

The power member is a Newman totally enclosed fan-cooled A.C. 3-phase 50-cycles motor, fixed to a swivel platform mounted on the cross-member, at approximately 3 feet above floor level. An important feature of the Newman motor is its high starting torque, so that it is particularly suitable for incorporation in a unit of this nature, where a quick and powerful start is desirable.

All parts of the unit are readily accessible. To adjust the tension on either



The Newman Unit for dispensing with overhead belting.

the primary belt from the motor to the countershaft, or the secondary belt down from the countershaft to the machine, is only a matter of seconds. The primary belt is adjusted by swivelling the motor on the cross-member; the secondary belt by two adjusting screws raising or lowering the bearing brackets.

Push-button control is fitted on the front of the machine-tool, within easy reach of the operator. Cumbersome belt-striking gear is dispensed with, and action is instantaneous for starting and stopping.

Power and maintenance costs are greatly reduced by introduction of the solus drive system, and the Newman Unit provides an inexpensive way of effecting the change-over, whether for an odd machine or two or for many. Newman Industries, Ltd., Yate, Bristol, have priced literature available on request.

Rolls Dividend

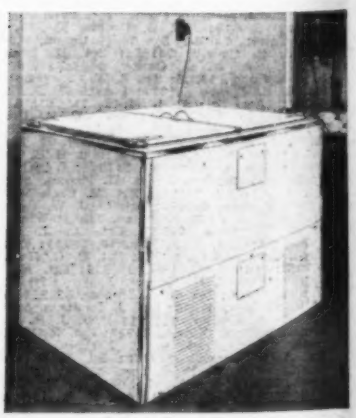
AT a meeting of the Board of the Rolls-Royce Company it was decided to recommend the undermentioned dividend. Final on Ordinary shares 15 per cent. actual (3s. per share) less income-tax at 8s. 6d. in the £, making 20 per cent. for the year ended December 31, 1939. Net profit for the year after providing for E.P.T. and N.D.C. £464,263 (last year £479,950 prior to N.D.C. provision).

Storing Duralumin Rivets

IT has been found that if duralumin rivets are stored at a temperature of about minus 10 deg. F. after heat treatment and quenching, they maintain their usable state for an extended period, and therefore require normalising at less frequent intervals than is otherwise necessary. Among the manufacturers of refrigeration equipment, Messrs. Coldair, Ltd., an associated company of The General Electric Co., Ltd., have been active in this field. They have made several installations, including one at the Gloster Aircraft Factory.

The cabinets which are used for the purpose in this factory are designed to facilitate rapid loading and unloading of the low-temperature compartment with the minimum rise of temperature, arrangements having been made to maintain an internal temperature of −10 deg. F. to −15 deg. F. with an ambient temperature of 80 deg. F. They are constructed from heavy-gauge material which ensures them a long and useful life under hard factory conditions. The capacity is 2.9 cubic feet and the galvanised-steel storage compartment which measures 22in. x 10¾in. x 21¾in. deep holds 500 lb. of rivets at a filling. Overall dimensions are 4ft. 4in. long x 2ft. 11in. wide x 2ft. 8in. high, and the general finish white or black enamel with silver-finished steel frame.

The specification includes 4in. compressed-cork insulation, galvanised mild-steel working top, thermostatic temperature control, and dial thermometer. The condensing unit comprises a standard ½ h.p. twin-cylinder compressor and ½in. solid-drawn copper cooling coils.



The special Coldair refrigeration cabinet for storing duralumin rivets after they have been normalised.